VOLUME 7 NUMBERS 1–6

Scientific and Technical Aerospace Reports

Abstracts

January–March 1969

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JANUARY 8, 1969

VOLUME 7 • NUMBER 1

N69-10001—N69-11299

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TIONAL AERONAUTICS AND SPACE ADMINISTRATION

STAR

Scientific and Technical Aerospace Reports

A SEMIMONTHLY ...

JANUARY 8, 1969

VOLUME 7 • NUMBER 1

N69-10001—N69-11299

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INTRODUCTION

SPECIAL NOTICE

Starting with this issue of *Scientific and Technical Aerospace Reports (STAR)*, several significant changes have been made, not only in the format of this publication, but also in procedures for requesting the documents cited. These are explained in the Introduction.

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INTRODUCTION

WHAT *STAR* IS

Scientific and Technical Aerospace Reports (STAR) is a comprehensive abstracting and indexing journal covering worldwide report literature on the science and technology of space and aeronautics. It is published on the 8th and 23rd of each month.

The following publications are abstracted in *STAR*:

Scientific and technical reports of the National Aeronautics and Space Administration and its contractors; scientific and technical reports of government agencies, universities, and research organizations throughout the world.

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The first section of *STAR* contains citations and abstracts arranged in 34 subject categories. Following are six indexes: subject, personal author, corporate source, contract number, report/accession number, and accession/report number. Separate cumulative indexes are published quarterly, the fourth quarterly being an annual index for the calendar year.

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By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts* is issued in coordination with *STAR*. Each journal appears on alternate weeks. *IAA* uses subject categories identical with those in *STAR*, and publishes similar indexes. *IAA*'s worldwide coverage of books and journals complements *STAR*'s worldwide report coverage. The two publications thus provide comprehensive access to current literature on aerospace science and technology.

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Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. 1

02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. 9

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Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. 20

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Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **51**

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Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **58**

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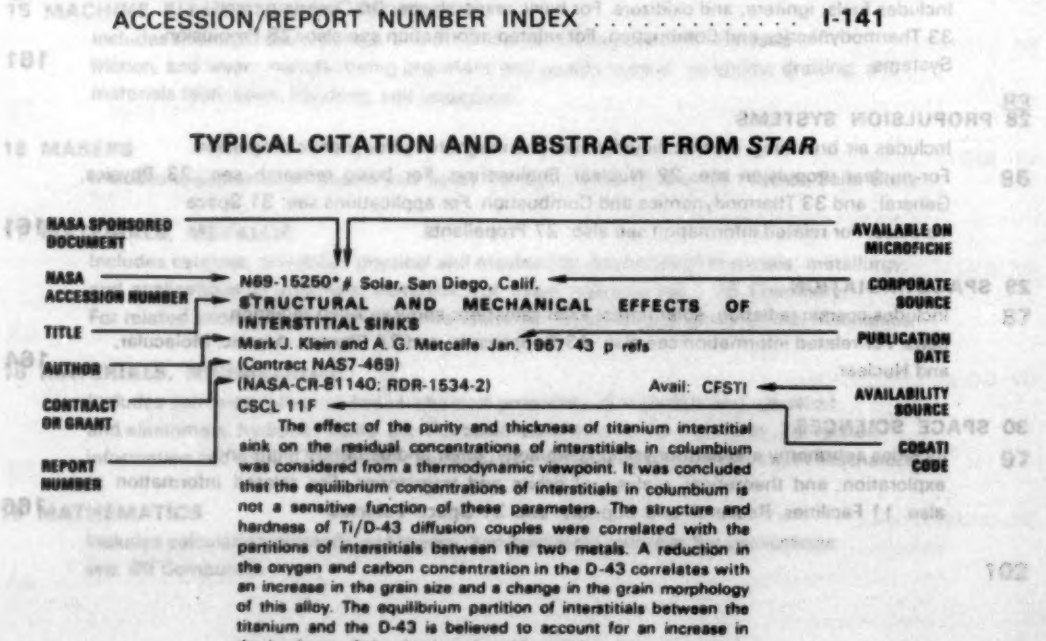
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N69-15250* # Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
(NASA-CR-81140; RDR-1534-2)
Avail: CFSTI
CSCL 11F
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43.
Author

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Scientific and Technical Aerospace Reports

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Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N69-10054*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CALCULATED AND EXPERIMENTAL HINGE MOMENTS ON A TRAILING-EDGE FLAP OF A 75° SWEPT DELTA WING AT MACH 6

J. Wayne Keyes and George C. Ashby, Jr. Washington Dec. 1967 28 p refs

(NASA-TN-D-4268) Avail: CFSTI CSCL 01A

The hinge moment characteristics of a trailing-edge flap on a 75° swept delta wing have been investigated at a Mach number of 6.0 and a Reynolds number of 4.03×10^6 (based on the root chord of the delta wing). This investigation was conducted at angles of attack from 30° to 90° and flap-deflection angles from 0° to 30°. The boundary layer in the area of the wing–flap junction was considered to be transitional for angles of attack up to approximately 60° and laminar for angles of attack from 60° to 90°. Both a sharp and blunt leading-edge wing and two flap aspect ratios were used in the investigation. Although the flow on the wing and flap was found to be complex, a meaningful analysis of the data can be made for the nonseparated case if the local flow regime over the wing and flap is properly classified (subsonic or supersonic) for each angle of attack and flap-deflection angle. The slope of the hinge moment curves changed at approximately the same angle of attack that the flow regimes were predicted to change when tangent-cone and oblique shock theories were used. Boundary layer separation over the flap was not extensive for flap deflections less than 20°. The type of boundary layer could have a strong influence on the hinge moments for flap deflection angles large enough to cause boundary layer separation. Author

N69-10186# Advisory Group for Aerospace Research and Development, Paris (France).

HYPERSONIC BOUNDARY LAYERS AND FLOW FIELDS

May 1968 464 p refs Presented at a Specialists' Meeting of the Fluid Dyn. Panel of AGARD, London, 1-3 May 1968

(AGARD-CP-30) Avail: CFSTI

Papers on hypersonic boundary layers and flow fields from the AGARD Fluid Dynamics Panel meeting are presented. For individual titles see N69-10186 to N69-10212.

N69-10187*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EXPERIMENTS WITH HYPERSONIC TURBULENT BOUNDARY LAYERS ON FLAT PLATES AND DELTA WINGS

Mitchel H. Bertram, Aubrey M. Cary, Jr., and Allen H. Whitehead, Jr. *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 21 p refs (See N69-10186 01-01)

Avail: CFSTI CSCL 01A

Recent hypersonic turbulent boundary layer experiments and proposed prediction methods pertinent to the problems of the effect of wall temperature on skin friction and heat transfer, the transformation of the compressible boundary layer to the constant density type, and the heat transfer to delta wings are considered. The level of the turbulent heat transfer coefficient is found to be little affected by significant changes in wall-temperature level. Coles' transformation as modified by Baronti and Libby has been examined by utilizing turbulent boundary layer profiles covering a wide range of Mach number and wall temperature ratio. Some success is found for the transformation up to the lower end of the hypersonic range and down to moderately low wall temperature ratios. For delta wings at low angle of attack, in cases where the flow near the surface is essentially streamwise, strip application of successful flat plate methods gives good predictions of the turbulent heat transfer if the pressures are known. On the lee side of delta wings where vortices are indicated, predictions by strip theory are surprisingly good in general; but predictions can be poor near the center line where the heat transfer is high. Ability to predict the heat transfer to delta wings appears to be contingent upon the ability to predict the flow field. Author

N69-10188# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.

EXPERIMENTAL MEASUREMENTS OF COLD WALL TURBULENT HYPERSONIC BOUNDARY LAYERS

J. H. Perry and R. A. East *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 20 p refs (See N69-10186 01-01)

Avail: CFSTI

Measurements of cold wall turbulent hypersonic boundary layer stagnation pressure and stagnation temperature profiles were made on the wall of a conical nozzle in a hypersonic gun tunnel facility. A high speed traversing pitot tube and a short time response stagnation temperature probe were developed for the profile measurements. The data was obtained for a freestream Mach number range of 8 to 11.5, a freestream Reynolds number range of 5×10^6 to 2.7×10^7 and wall to freestream stagnation temperature ratios of .26 to .36. The measured temperature profiles compare unfavorably with available semi-empirical temperature/velocity functions. Transformation of the velocity profile

to the equivalent incompressible form, using the Baronti and Libby method, gave a successful transformation of the "law of the wall" and fair transformation of the "law of the wake". Non-correspondence of the pressure gradient in the wake profile of the compressible flow to that in the related low speed flow was noted. Spaulding-Chi and Somer Short T' methods for determining the skin friction coefficient were compared to the experimental results. Neither method showed a satisfactory correlation. The measured heat transfer rate, with the Reynolds analogy, compared favorably with the measured skin friction coefficients. Author

N69-10189# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THEORY AND EXPERIMENT FOR THE STRUCTURE OF SOME HYPERSONIC BOUNDARY LAYERS
Eric J. Softley and Robert J. Sullivan *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 18 p refs (See N69-10186 01-01)
Avail: CFSTI

A recent study of hypersonic boundary layer transition on a 5° cone has given the opportunity to examine the structure of both laminar and turbulent boundary layers on sharp and blunt cones at edge Mach numbers of 10. From pitot probe and total temperature measurements, profiles of velocity and Mach number were obtained. The laminar boundary layer results are compared with a non-similar boundary layer theory calculated on a GE 635 computer. For the turbulent boundary layer, the total temperature is far removed from the Crocco relationship. Author

N69-10190# Royal Aircraft Establishment, Bedford (England).
THE INTERACTION OF A TURBULENT BOUNDARY LAYER AND A SHOCK AT HYPERSONIC MACH NUMBERS
D. F. Myring *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 19 p refs (See N69-10186 01-01)
Avail: CFSTI

Equations describing the phenomenon of turbulent shock wave boundary layer interaction are presented. The basic model adopted is the conventional one in which the boundary layer displacement effect is assumed to induce streamwise pressure gradients which in turn influence the boundary layer growth. The boundary layer assumption of constant static pressure across the layer is discarded and new hypotheses are invoked concerning the magnitude of the normal pressure gradient. On integration of the final set of simultaneous equations, three solutions are identified. One of these is shown to correspond to the phenomenon of shock interaction and comparisons with experiment are given. The theoretical effects of Reynolds number, Mach number, surface curvature, wall temperature and initial velocity profile on the pressure coefficient at separation are presented. Singularities which appear at low wall temperatures are examined and a simple procedure is presented by which the magnitude of the corresponding discontinuities in the variables may be calculated. Author

N69-10191# Sandia Corp., Albuquerque, N. Mex.
LAMINAR AND TURBULENT FLOW PAST AXISYMMETRIC CONVEX CORNERS AT HYPERSONIC MACH NUMBERS
Kenell J. Touryan and Thomas J. Tyson (Dyn. Sci. Corp., Monrovia, Calif.) *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 16 p refs Supported by AEC (See N69-10186 01-01)
Avail: CFSTI

Theoretical and experimental wall pressure distributions on small nose-bluntness ratio cone-cylinder configurations in hypersonic flow are presented. Both laminar and turbulent boundary layers are considered. The expansion over the cone-cylinder shoulder is emphasized. The theoretical computations are comparative studies compiled from various aerospace companies in the U. S. A., including an exact theoretical method for the laminar corner flow. The experiments include hypersonic wind tunnel data and a novel technique using rocket sleds with Mach and Reynolds number ranges of $1.5 \leq M \leq 7$ and $3 \times 10^6 \leq Re/ft \leq 42 \times 10^6$, respectively. A special emphasis is placed on obtaining experimental data with repeatability of better than 5 percent. The measured data are compared with the theoretical calculations and the various discrepancies are analyzed. Author

N69-10195# Ministry of Technology, London (England).
THE USE OF KNOWN FLOW FIELDS AS AN APPROACH TO THE DESIGN OF HIGH SPEED AIRCRAFT
J. Seddon and A. Spence (Roy. Aircraft Estab., Bedford, Eng.) *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 22 p refs (See N69-10186 01-01)
Avail: CFSTI

The flow field approach to the design of non-slender lifting high speed aircraft is reviewed. The method used, characterized by flow nonlinearity resulting from the presence of shock waves, is described in terms of both upper and lower surface design. Flow fields for direct lift and the comparison and combination of direct and interference lift are considered for the lower surface flow field. Lifting efficiency is discussed, including momentum analysis and estimated of overall lift drag ratio. Extensions of the method permit the simulation of the propulsion system and other features involved in aircraft design. M.W.R.

N69-10196# Cambridge Univ. (England). Dept. of Engineering.
CALCULATIONS OF THE PRESSURE DISTRIBUTION ON LIFTING CONICAL WINGS WITH APPLICATIONS TO THE OFF-DESIGN BEHAVIOUR OF WAVERIDERS
L. C. Squire *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 22 p refs (See N69-10186 01-01)
Avail: CFSTI

Charts are presented for the calculation of pressure distributions and shock shapes on conical wings with diamond and caret (Nonweiler) cross-sections. These charts are based on extensions to Messiter's first order correction to simple Newtonian theory. Comparisons of measured and calculated pressure distributions show good agreement over a wide range of cross-section shapes and Mach numbers. This good agreement allows the theory to be used to build up a systematic description of the off-design behaviour of conical wave-rider wings. Author

N69-10197# Royal Aircraft Establishment, Bedford (England).
EXPERIMENTAL RESULTS FROM THREE CONE-FLOW WAVERIDERS
J. Pike *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 12 p refs (See N69-10186 01-01)
Avail: CFSTI

Experimental results are presented for two waverider models with sharp leading edges and a third with a rounded leading edge. At a particular incidence and Mach 4 the flow supported by the compression surfaces of the models can be predicted theoretically. This predicted flow is shown to agree closely with experimental measurements of lower surface pressures, the shock wave shape and the surface streamline pattern. At other incidences or Mach numbers the flow cannot be predicted theoretically. The experimental results show, however, that for high incidence at M = 4 the pressures are remarkably uniform; and at constant incidence with Mach number decreasing, the shape of the shock wave changes smoothly, including its detachment from the leading edge. Leading edge rounding is shown to affect pressures only close to the leading edge. Author

N69-10198# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).
EXPERIMENTAL INVESTIGATIONS OF WAVE RIDERS IN THE MACH NUMBER RANGE FROM 8 TO 15

K. Kipke *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 17 p refs (See N69-10186 01-01)
Avail: CFSTI

A series of wave riders (caret wings) were investigated in hypersonic gun tunnel in the Mach number range from 7.9 to 15.5, and at corresponding Reynolds numbers from $2.7 \cdot 10^6$ to $1.4 \cdot 10^5$. The tests included three component force measurements, pressure distribution measurements, and determination of the shock wave angle by flow visualization. The experimental data were compared with simple wedge theory, wedge theory including viscous effects, and an extended Newtonian theory depending on two hypersonic similarity parameters only. Large viscous interaction effects were found to have considerable influence on the lift-to-drag ratio, pressure distribution, and shock wave angle. Author

N69-10199# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
HYPERSONIC VISCOUS-INVISCID INTERACTIONS BY A NEW TYPE OF ANALYSIS
S. G. Rubin, S. Rudman, T. C. Lin, and M. Pierucci *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 16 p refs (See N69-10186 01-01)
(Contract AF 49(638)-1623)
Avail: CFSTI

Hypersonic viscous-inviscid interactions are treated by the finite-difference solution of a single set of equations valid throughout the boundary layer and shock wave structure, as well as inviscid regions. Primary interest is concerned with the flow structure and surface properties in the continuum merged layer, near a sharp leading edge, and the strong-interaction domain further downstream. Among the geometries considered are (1) axisymmetric flow over sharp cones; (2) two-dimensional channel flow with interior oblique shock wave interaction, and for a finite length channel, the exhaust interaction with the hypersonic flow outside the channel; and (3) the three-dimensional geometry of a finite width flat plate having a sharp leading edge. Results are presented for flow structure, wall pressure and heat transfer. For the three-dimensional geometry, shock wave patterns are described and comparisons with two-dimensional flat plate results are shown. Author

N69-10200# New York Univ., N. Y. Dept. of Aeronautics and Astronautics.
AN INVESTIGATION OF THREE-DIMENSIONAL JET CONTROL INTERACTION ON A CONICAL BODY
V. Zakkay, J. Erdos, and W. Calarese *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 22 p refs (See N69-10186 01-01)
(Contract F33615-68-C-1184)
Avail: CFSTI

An experimental investigation of the interaction of a finite-span jet issuing normal to the surface of a 7° semi-vertex angle sharp cone at a free stream Mach 6 was performed. The jet slot was contained within a peripheral angle of 60°, and located at a distance midway along the length of the cone surface. A range of unit Reynolds number of 2×10^6 to 4×10^7 per foot was covered to study the interaction for laminar, transitional and fully turbulent flows over the conical surface of the body. Data were also obtained for three-dimensional separation and reattachment lines by injecting a dye at the surface. Results indicate that the total normal force coefficient produced by a finite-span jet is not degraded by three-dimensional effects. The normal force coefficient measured in these tests equals or exceeds the normal force per unit span obtained in experiments with two-dimensional flows at the same Mach number and jet mass flux ratio. A new theoretical model is proposed to describe the structure of the jet interaction flow field. Author

N69-10201# Avco Corp., Wilmington, Mass. Aerosphysics Lab.
HYPERSONIC INTERACTIONS ABOUT A SLENDER CONE INDUCED BY RADIAL MASS INJECTION
P. G. Simpkins *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 14 p refs (See N69-10186 01-01)
Avail: CFSTI

The interaction between a two-dimensional underexpanded jet and the hypersonic flow over a cone at a free stream Mach 13 is reported. The jet emanates radially from a slot which is normal to the axis of symmetry of the right circular cone which has a semi-angle of 5°. The influence of variations in free stream Reynolds number, jet pressure ratio, secondary mass flux, and yaw angle are investigated for regular and blunted cone configurations. Measurements of the surface heat transfer and pressure distributions far upstream of the jet are consistent with accepted boundary layer separation predictions in the free interaction region. In the immediate vicinity of the efflux, on both the upstream and downstream side, the measurements indicate the existence of reattachment regions. These are associated with the substantial increases observed in both the local pressure and heat transfer distribution. Throughout the length of the cone behind the jet, the heat transfer is found to be less than the undisturbed cone value. This is attributed to a film cooling effect. When the jet pressure ratio is maintained at a constant value, the separation length ahead of the efflux is found from schlieren photographs to be independent of the free stream Reynolds number. This implies that the geometrical features of the separated flow field are similar and that the free shear layer is thin enough for the viscous parameters to be unimportant. Further observations indicate that when the secondary mass flux is constant, the separation length decreases with increasing free stream Reynolds number. Author

N69-10202# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
HYPERSONIC FLOW IN REACTANGULAR AND NON-RECTANGULAR CORNERS
R. J. Cresci, S. G. Rubin, and C. T. Nardo *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 16 p refs (See N69-10186 01-01)
(Contract AF 49(638)-1623)
Avail: CFSTI

An investigation of the behavior of the three-dimensional hypersonic flow along intersecting planes as conducted, considering both the viscous and inviscid flows and their mutual interaction. The experimental program involved measurements of surface pressures and heat transfer rates in the vicinity of corners with various included angles. The local forces and shear stresses obtained yield some information on the nature of the three dimensional boundary layer behavior in this region. Pitot pressure profiles were obtained and utilized in the determination of the complex intersecting shock structure in the corner. The test data were obtained at a nominal free stream Mach 12 and a Reynolds number producing values of $\bar{X}$ as high as 15. A theoretical analysis of the corner flow was obtained by using the finite difference solution technique previously proposed by Rubin and extended here to the three dimensional corner configuration. Author

N69-10203# National Aeronautical Establishment, Ottawa (Ontario).
THE EXTERNAL FLOW FIELD ABOUT YAWED CIRCULAR CONES
W. J. Rainbird *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 18 p refs (See N69-10186 01-01)
Avail: CFSTI

Experimentally determined pressure distributions, surface shear stresses, and detailed external flow field measurements on a yawed, 54-inch-long, 5° semiangle cone, were made under high Reynolds number conditions ($R_{L_\infty} = 3.4 - 6.8 \times 10^7$) at Mach numbers of 1.80 and 4.25 and up to large relative incidence. Some results from a 40.6-inch-long, 12 1/2° semiangle cone, tested

under similar conditions, are also included. The development of the viscous flow and separation about circular cones, with increasing relative incidence and at high Reynolds number, is shown to be a gradual process involving the formation of symmetrically disposed lobes of vortical fluid which develop into vortices and which remain comparatively close to the cone surface on either side of and near the leeward generator. Numerical methods for the solution of the inviscid supersonic flow about yawed circular cones give excellent predictions up to moderate relative incidence (about 1.2), provided mixed flow conditions with internal shock waves do not occur. An inviscid flow model with free vortex sheets is needed to approximate the real flow with separation at larger relative incidence ($\alpha/\theta_c > 1.5$).
Author

N69-10204# Aix-Marseilles Univ. (France). Inst. des Fluides.
THEORETICAL AND EXPERIMENTAL STUDY OF THE BOUNDARY LAYER AROUND A CIRCULAR CONE AT INCIDENCE TO A HYPERSONIC STREAM [ETUDE THEORIQUE ET EXPERIMENTALE DE LA COUCHE LIMITE AUTOUR D'UN CONE CIRCULAIRE PLACE EN INCIDENCE DANS UN COURANT HYPERSONIQUE]
D. Guffroy, B. Roux, J. Marcillat, R. Brun, and J. Valensi *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 18 p refs In FRENCH (See N69-10186 01-01)
Avail: CFSTI

Theoretical and experimental results are reported at Mach 7 and Mach 9 relating to the characteristics of flow around a cone at 9° half-angle. Wall flow studies were made by measures of static pressure and density of the convective heat flux and by flow visualization. A separation was evident in the region least exposed to the wind for incidences much less than the half-angle. The boundary layer did not separate and remained laminar in all directions for Reynolds numbers of 25,000 and 12,000, but at Re = 110,000 the transition involved turbulent reattachment. For exterior flow, explorations with a pitot probe permitted determination of the form of the shock wave for different incidences and the localization of two apex eddies.
Transl. by M.W.R.

N69-10205# AVCO Corp., Wilmington, Mass. Missile Systems Div.
DISPLACEMENT INTERACTION AND FLOW SEPARATION ON CONES AT INCIDENCE TO A HYPERSONIC STREAM
Torstein K. Fannelop and George D. Waldman *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 20 p refs (See N69-10186 01-01)
(Contract F04694-67-C-0060)
Avail: CFSTI

A theoretical analysis is presented for the boundary layer flow about a blunted cone at incidence to a hypersonic stream. The boundary layer problem is formulated in terms of streamline coordinates and the equations which result are solved exactly by means of an implicit finite difference procedure. Methods available for solving the three dimensional inviscid flow field are examined and found to be inefficient relative to the present boundary layer method. A semi-empirical method for calculating the inviscid surface pressure rapidly and accurately is presented together with details of the corresponding streamline tracing procedure. The method can account for changes in the local inviscid pressure due to boundary layer displacement effects. Converged solutions of the displacement pressure interaction problem are obtained by coupling the boundary layer and inviscid methods in a step-by-step iteration procedure. The effects of displacement interaction are particularly important on the leeward side. The relationship between these effects and incipient separation is discussed.
Author

N69-10206# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THEORETICAL AND EXPERIMENTAL STUDY OF HYPERSONIC FLOW AROUND A BLUNT BODY AT INCIDENCE [ETUDE THEORIQUE ET EXPERIMENTALE DE L'ECOULEMENT HYPERSONIQUE AUTOUR D'UN CORPS MOUSSE EN INCIDENCE]
Rene Ceresuela, Guenter Kretzschmar, and Colmar Rehbach *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 14 p refs In FRENCH; ENGLISH summary (See N69-10186 01-01)
Avail: CFSTI

The aerodynamic field at Mach 10 around a very blunt cone of low apex angle was calculated by Babenko's method for incidence angles of 5°, 10° and 20°; the numerical calculation diverged and gave negative pressures in the case of the 20° incidence angle. Comparison with wind-tunnel results showed that the shock-wave was predicted with an excellent precision; and that the theoretical and experimental local pressures were in good agreement except for high incidence angles on the upper part of the body, where a boundary layer separation induced a horse-shoe shaped vortex. These laminar boundary layer tests measured heat rates greater than those predicted in most cases. Generally, the divergence between theoretical and experimental results remained confined to zones where the heat rates and the pressure levels were low; therefore, Babenko's method leads to an evaluation sufficiently close to the real thermal and aerodynamic loads on a very blunt axisymmetrical body at fairly high angles of incidence.
Author

N69-10207# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
STUDY OF SUPERSONIC AND HYPERSONIC FLOW AROUND A SLENDER WING AT INCIDENCE [ETUDE DE L'ECOULEMENT SUPERSONIQUE ET HYPERSONIQUE AUTOUR D'UNE AILE ELANCEE EN INCIDENCE]
Bernard Monnerie and Henri Werle *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 19 p refs *In* FRENCH; ENGLISH summary (See N69-10186 01-01)
Avail: CFSTI

Aerodynamic field around a 75° sweepback wing with sharp leading edge was studied at Mach numbers 1.9 to 4 and 7, which correspond to values of the Mach number normal to the leading edge for subsonic, sonic and supersonic flow. The analysis of the results obtained by visualization and surveys of the total pressure leads to the presentation of a schematic description of the flow on the upper surface of the wind, particularly of the separated zones.
Author

N69-10208# Imperial College of Science and Technology, London (England). Dept. of Aeronautics.
HYPERSONIC LAMINAR BOUNDARY LAYER GROWTH IN AN ADVERSE PRESSURE GRADIENT
Henry A. Fitzhugh *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 16 p refs (See N69-10186 01-01)
Avail: CFSTI

A number of laminar boundary layer theories were tested against each other and against experiment. A comprehensive set of exact solutions to the boundary layer equations have been computed using the finite-difference computer program of Sells in the range M = 2–10, with and without wall cooling. Theories tested against experimental results are those of Cheng (strong interaction), Monaghan (correlation technique), the Discontinuity/Analogy Method of Stroud and Miller as extended by the author, and the method of Hankey for shock wave-boundary layer interactions and compression corner flows. The exact computer results show the errors in many of the more appropriate methods available for the case where $U_e = U_\infty(1 - X/L)$, but no comparison with experiment was possible. The theories tested against

experimental results were all shown to be inadequate, and the final conclusion is that no theory has been tested sufficiently to warrant its acceptance as a prediction method. Author

N69-10209# New York Univ., N. Y. Dept. of Aeronautics and Astronautics.
VISCOUS HYPERSONIC FLOW PAST SLENDER BODIES AT INCIDENCE
Robert Vaglio-Laurin *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 13 p refs (See N69-10186 01-01)
(Grant AF-AFOSR-818-66)
Avail: CFSTI

A physical model and a simplified analysis applicable to three-dimensional hypersonic laminar boundary layers with large cross flow are presented. It is shown that the boundary layers in question can be divided into two regions: (1) an outer region where the local density and momentum flux per unit area are comparable to those in the inviscid stream while the cross flow is negligible; and (2) an inner region, comprising the major portion of the boundary layer, where the local density and momentum flux per unit area are very small (compared to those in the inviscid flow), the cross flow is important, and the state of motion is controlled by the viscous forces. The flow in the inner region is Couette-like in the streamwise direction and Poiseuille-like in the direction normal to the streamlines of the inviscid flow; the velocity and enthalpy profiles there are governed by ordinary differential equations with solutions that depend parametrically on the local pressure gradients, the local geometry of the inviscid flow streamlines, the local wall temperature ratio and the local thickness of the boundary layer. The only unknown parameter, the boundary layer thickness, can be determined either by matching the solutions in the two regions or by integral momentum considerations employing the aforementioned "exact" profiles for the inner region. A preliminary assessment of the integral method for a two-dimensional flow indicates good agreement between theory and experiments. Author

N69-10210# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
VORTICAL LAYERS IN SUPERSONIC CONICAL FLOW
R. E. Melnik *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 20 p refs (See N69-10186 01-01)
Avail: CFSTI

A theoretical analysis of supersonic flow over slightly yawed conical surfaces is presented. The cross section of the cone is assumed to be nearly circular, but otherwise arbitrary. The method of matched expansions is employed and a solution is obtained by a systematic expansion from the known solution for supersonic flow over an unyawed circular cone. The behavior of the uniformly valid solution at vortical singularities is found to be a formal asymptotic solution at these points. There is no indication of the lift-off behavior of the vortical singularity suggested by Ferri. Analytic results are given for the second order uniformly valid solutions for a yawed circular cone. Numerical results for the first order composite solution for the entropy distribution on an elliptic cone are also presented. Author

N69-10211 Centre National de la Recherche Scientifique, Meudon (France). Lab. d'Aerothermique.
STUDY OF FLOW AT MACH 18 AROUND A FLAT PLATE AT INCIDENCE AND WITH A VARIABLE LEADING EDGE [ETUDE DE L'ECOULEMENT A UN NOMBRE DE MACH DE 18 AUTOUR D'UNE PLAQUE PLANE EN INCIDENCE ET A BORD D'ATTAQUE]
J. Allegre and Ch. Bisch *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 8 p refs In FRENCH (See N69-10186 01-01)
Avail: CFSTI

Measurements were made of the wall pressure and the stopping pressure around a flat plate with incidence varying from −6° to 9° and with leading edge thickness between 0.07 mm and 1.5 mm. These measures indicated the variations and intensity of the shock, variations which brought about important modifications in wall pressure values. Flow visualization photographs by electric pulses permitted verification of the location and form of the shock. Transl. by M.W.R.

N69-10212*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Aerodynamic Research Dept.
STUDIES OF THREE-DIMENSIONAL, COMPRESSIBLE BOUNDARY LAYERS ON BLUNT LIFTING ENTRY BODIES
Sang-Wook Kang, William J. Rae, and Michael G. Dunn *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 27 p refs (See N69-10186 01-01)
(Contract NAS5-9978)
Avail: CFSTI CSCL 01A

Theoretical studies of the three-dimensional, laminar, compressible boundary layer with mass injection are reported. Applications are given to cases typical of the heat shield of the Apollo vehicle during lifting reentry. The studies are divided in two parts. The first part, reviewed only briefly here, is restricted to the case of small secondary flow. The second part, which makes up the major content of this paper, consists of an integral method in which the small secondary flow restriction need not be made. Applications of the latter method are described; significant nonsimilar effects associated with mass injection and inviscid streamline curvature are observed. Author

N69-10215*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A METHOD FOR DETERMINING SURFACE PRESSURES ON BLUNT BODIES OF REVOLUTION AT SMALL ANGLES OF ATTACK IN SUPERSONIC FLOW
Charlie M. Jackson, Jr., Wallace C. Sawyer, and Rudean S. Smith
Washington Nov. 1968 104 p refs
(NASA-TN-D-4865) Avail: CFSTI CSCL 01A

Existing theoretical techniques have been modified and combined to provide a method for computing surface pressure distributions on blunt bodies with spherical nose caps and arbitrary afterbody shapes. The method consists basically of modified Newtonian theory in the stagnation region with second-order shock-expansion theory used when the surface flow becomes supersonic. The second-order shock-expansion theory is most conveniently applied to rotationally symmetric bodies; therefore, to use this theory at small angles of attack, the body meridian lines are used to generate equivalent bodies of revolution from which the meridian pressure distributions are obtained. A complete, consistent set of experimental surface pressure data is presented for two typical blunt reentry configurations to permit evaluation. The test conditions provide surface pressure distributions for six Mach numbers from 1.50 to 4.63 and four angles of attack from 0° to 12° for each model. A comparison of the present theoretical method with these experimental data indicates that this method gives adequate engineering estimates of the surface pressures on blunt bodies at moderate angles of attack except where flow separation or detached secondary shock waves are present. Author

N69-10294*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF POROUS BLEED IN A HIGH PERFORMANCE AXISYMMETRIC, MIXED COMPRESSION INLET AT MACH 2.50
Robert W. Cubbison, Edward T. Mateason, and David F. Johnson
Washington Nov. 1968 37 p refs
(NASA-TM-X-1692) Avail: CFSTI CSCL 01C

A study to determine the effect of boundary layer bleed location and the amount of total bleed flow on the performance of a mixed compression, axisymmetric, reflecting-shock inlet was

conducted in the Lewis 10- by 10-Foot Supersonic Wind Tunnel at Mach 2.498. Best overall inlet performance was obtained with 2.5 percent supercritical bleed located just downstream of the last cowl and centerbody shock reflection points in the supersonic diffuser. Critical pressure recovery was 0.899 with 16.5 percent distortion, and the subcritical operating range was 7.8 percent of engine corrected airflow. Distortion considerations may dictate either more bleed or use of vortex generators. Author

N69-10324# Department of Supply, Melbourne (Australia). Aeronautical Research Labs.

THE EFFECT OF CHOICE OF SECTION FOR AXIAL-PUMP IMPELLER BLADING ON CAVITATION PERFORMANCE

D. A. Frith Apr. 1968 31 p refs

(ARL/ME-294) Avail: Issuing Activity

Conformal mapping can be used to generate aerofoils in cascade having profiles, staggers and solidities applicable to axial-flow pump impellers. This technique has been employed in studying the velocity distributions over a number of designs in order to determine the major factors influencing the minimum pressure on the aerofoil and the resultant likelihood of cavitation. This study has shown that the thickness of the aerofoil plays an important part in the determination of cavitation-free range of operation. There is also an optimum solidity above which blockage decreases efficiency and increases the likelihood of cavitation. Finally, it is shown that selection of the design incidence of a pump impeller is important in determining the operating point relative to the cavitation boundaries. Author

N69-10343*# McDonnell-Douglas Co., Long Beach, Calif.

A NUMERICAL SOLUTION FOR THE MINIMUM INDUCED DRAG, AND THE CORRESPONDING LOADING, OF NONPLANAR WINGS Final Report

J. L. Lundry Washington NASA Nov. 1968 39 p refs

(Contract NAS1-7484)

(NASA-CR-1218; DAC-66900) Avail: CFSTI CSCL 20D

A numerical procedure has been developed for the accurate computation of the minimum induced drag, and the associated loading, of nonplanar wings. The minimum induced drag and the loading are determined by the solution of a potential problem about the shed vortex wake in the Trefftz plane. The potential problem is analyzed in an auxiliary mapping plane that is related to the physical plane by the Schwarz–Christoffel transformation; the procedure can therefore be applied to configurations with front views that can be approximated by straight line segments. The success of the method depends on an iteration that converges satisfactorily for most cases. Comparisons of results of the method with results of known test cases show that errors in the minimum induced drag and in the corresponding loading are of the order of 10^{-4} when the method is programmed in single precision arithmetic for an IBM 7094. Author

N69-10393# Oxford Univ. (England). Dept. of Engineering Science.

TWO-PHASE, TWO-COMPONENT CRITICAL FLOW IN A VENTURI

R. V. Smith (Ph.D. Thesis) Jun. 1968 240 p refs

(MR-25) Avail: Issuing Activity

This study establishes a functional relationship between the primary flow variables at, and just upstream of, the point of critical or choking flow for a liquid-gas mixture. The primary variables were pressure, mass flow rate, quality or a liquid-gas mass flow rate, and the geometry of the flow channel. The specific subject treated was air-water flow in a venturi. The experimental apparatus consisted of an annular venturi installed in an air-water flow loop. The core of the venturi could be moved axially. This made it possible to measure the axial variations of pressure along the venturi by means of a single pressure tapping rather than by an array of tappings. Good agreement was obtained between experimental and analytical results throughout a range of qualities from 0.018 to 1.0, and for two venturis with throat areas differing by a factor of two. Discussions of critical pressure ratios, fluid velocities and interface transport processes are included. Author

N69-10426# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AERONAUTICAL ENGINEERING (SELECTED ARTICLES)

19 Sep. 1967 32 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekhn. (Kazan), no. 2, 1966 p 9–18; 83–89

(AD-673807; FTD-HT-67-177) Avail: CFSTI

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N69-10427# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A NONLINEAR THEORY OF WINGS WITH SMALL ASPECT RATIOS

S. D. Yermolenko *In its* Aeron. Eng. (Selected Articles) 19 Sep. 1967 p 1–15 refs (See N69-10426 01-01)

Avail: CFSTI

A method is outlined for calculating the aerodynamic properties of rectangular wings of small aspect ratio in a subsonic compressible gas flow. The nonlinear dependence of lift and pitching moment coefficients on angle of attack is considered, as well as the rather large critical values of 30° to 40° angles of attack and the large induced drag. The method is based on a vortex arrangement and accounts for nonlinear effects of the angle of attack, that is, (1) the dependence on the aspect ratio of the correlation which exists between the angle formed by the wing surface and elementary vortex sheet and the angle of attack, and (2) the variation of this correlation with angle of attack and Mach number. A system of basic nonlinear algebraic equations is derived and solved by the method of successive approximations. The coefficient of the pitching moment with respect to the leading edge and the distribution of the center of pressure are determined at $\alpha = 0°, 10°, 20°$, and 30° Author

N69-10428# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCURRENT DISCHARGE OF TWO GAS FLOWS THROUGH A JET NOZZLE

Ye. D. Sten'kin *In its* Aeron. Eng. (Selected Articles) 19 Sep. 1967 p 16–25 refs (See N69-10426 01-01)

Avail: CFSTI

The mixing chambers in bypass turbojet engines are comparatively short (1 to 2 chamber diameters). Therefore, mixing is not complete since a length of 4 to 5 chamber diameters is required for complete mixing. This problem was analyzed using the assumption that the flow takes place without loss in total pressure and that at below critical flow velocities the pressure at the exit section equals the external pressure. The analysis based on Lyapunov's theorem for the flow stability yielded a formula which correlates the flow parameters of both streams. This formula showed that in the exit section, one stream is always subsonic while the other is supersonic. The formula can be used for designing mixing chambers of bypass turbojet engines or for afterburner mixing chambers. Author

N69-10558*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF VARIABLE STATOR AREA ON PERFORMANCE OF A SINGLE-STAGE TURBINE SUITABLE FOR AIR COOLING. 6: TURBINE PERFORMANCE WITH 70-PERCENT DESIGN STATOR AREA
Harold J. Schum, Edward M. Szanca, and Herman W. Prust, Jr. Washington Nov. 1968 24 p refs
(NASA-TM-X-1697) Avail: CFSTI CSCL 21E

The performance of this turbine is compared with those obtained for the design and the 130-percent design-stator-area turbines. Whereas the design turbine yielded an efficiency of 0.923 at its equivalent design operating condition, the closed turbine produced an efficiency of only 0.840 at the same operating point. This compares with 0.897 for the open turbine. The large loss of efficiency for the closed turbine is attributed mainly to the high velocities at the stator exit, incidence to the rotor, and substantially reduced reaction across the rotor. Author

N69-10732*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS OF 0.25-SCALE MODEL OF TOMAHAWK LAUNCH VEHICLE AT MACH NUMBERS FROM 2.30 TO 4.63
Lloyd S. Jernell Washington Nov. 1968 62 p refs
(NASA-TM-X-1684) Avail: CFSTI CSCL 01A

An investigation of several configurations of a 0.25-scale model of the Tomahawk launch vehicle has been conducted in the Langley Unitary Plan wind tunnel at Mach numbers from 2.30 to 4.63. The investigation included the effects of body fineness ratio, fin planform geometry, and fin cant angle for an angle of attack range of about −4° to 21° at roll angles from 0° to 67°. The results indicate that for the moment reference center employed, each configuration experienced pitch-up at angles of attack of approximately 8° to 10° at a Mach number of 2.30, with the angle of pitch-up decreasing with increasing Mach number. The larger fins delay pitch-up to a slightly higher angle of attack at all test Mach numbers. Canting the basic fins 1° was effective in producing rolling moment throughout the ranges of angle of attack and Mach number. Varying the roll angle resulted in large variations in the lateral force and moments above angles of attack of about 4° because of the effects of the forebody vortices acting on the fins. Author

N69-10789*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF ANGLE OF ATTACK AND BLUNTNESS ON THE SHOCK-LAYER PROPERTIES OF A 15° CONE AT A MACH NUMBER OF 10.6
Joseph W. Cleary Washington Nov. 1968 40 p refs
(NASA-TN-D-4909) Avail: CFSTI CSCL 01A

An experimental investigation was conducted to determine the effects of varying angle of attack and nose bluntness ratio on the shock layer properties of a typical conical entry body. Distributions of pitot and static pressures were measured across the shock layer of a cone with 15° semiapex. The measurements were obtained from wing-tunnel tests in air at a Mach number of 10.6 and a free stream unit Reynolds number of 1.2×10^6 per foot. Results are presented at fore and aft axial positions for several circumferential angles when at angle of attack. Pitot pressure distributions demonstrate that the flow over the sharp cone was essentially conical except for the separated-flow region on the leeward side. Increasing bluntness ratio not only caused progressive deviations from conical flow but also affected the leeward flow separation pattern. Comparisons with inviscid theory show that because of bluntness, the flow remained attached on the lee side for an axial distance of several nose radii while farther aft, the flow separated in a manner similar to that of the sharp cone. On the windward side where the boundary layer was thin, inviscid theory accurately predicts the more salient properties of shock layers for both sharp and blunted cones. Author

N69-10899*# Aeronautical Research Council (Gt. Brit.).
ALLEVIATION OF LEADING-EDGE HEATING BY CONDUCTION AND RADIATION
E. C. Capey 1968 24 p refs supersedes RAE-TR-66311; ARC-28924
(ARC-R+M-3540; RAE-TR-66311; ARC-28924) Avail: CFSTI

A theoretical analysis is made of the equilibrium temperature distribution in the vicinity of the leading edge of a wing of a very high speed aircraft. Results are presented for thermally nonconducting leading edges and for leading edges composed of conducting material or containing inserts of high conductivity material to conduct heat downstream where it is lost by radiation. It is found that for aircraft cruising at Mach 5 the conductivity of typical structural material is sufficiently high to keep the leading-edge temperature down to a level not greatly exceeding that of the rest of the wing; for Mach numbers from 7 to 10 an insert of material of higher conductivity may have to be added. In any case the dependence of leading-edge temperature on leading-edge radius, which is important in the absence of conduction, becomes negligible when conductivity is taken into account. Author

N69-10926*# Scripta Technica, Inc., Washington, D. C.
ADVANCES IN TECHNIQUES OF MEASUREMENT OF AERODYNAMIC DERIVATIVES IN WIND TUNNELS BY THE FORCED OSCILLATION METHOD [PROGRES REALISES DANS LES TECHNIQUES DE MEASURE DES DERIVEES AERODYNAMIQUES EN SOUFFLERIE METHODE D'OSCILLATIONS FORCEES]
M. Scherer and J. Lopez NASA Nov. 1968 28 p refs Transl. into ENGLISH from AGARD Stability and Control (Paris), pt. 1, Sep. 1966 p 409–436
(Contract NASw-1694)
(NASA-TT-F-11764) Avail: CFSTI CSCL 01A

Progress by ONERA is reported for the measuring of aerodynamic derivatives by forced oscillation methods and a comparison is made between these and measures in flight. Development of the installations where forced oscillations can be made is described, including transonic and supersonic wind tunnels. Methods of measurement are detailed, and an overview of results obtained during the past four years is presented. Author

N69-11009*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT-TRANSFER AND PRESSURE DISTRIBUTIONS INSIDE THE HINGE-LINE GAP OF A WEDGE-FLAP COMBINATION AT MACH NUMBER 10.4
J. David Dearing and H. Harris Hamilton Washington Nov. 1968 57 p refs
(NASA-TN-D-4911) Avail: CFSTI CSCL 01A

Aerodynamic heating inside the gap separating a control flap from the adjacent support structure has been measured at a nominal free stream Mach number of 10.4. The model, a 10-percent-thick wedge, was fitted with a simple flap whose chord was 20 percent of the wedge chord. Angle of attack was varied to change the entrance-to-exit pressure ratio and resulted in local Mach numbers ahead of the gap entrance of from 5.9 to 7.9. Laminar, transitional, and turbulent boundary layers on the wedge near the entrance were obtained by combined variations in local Mach numbers and local Reynolds number. The heating in the gap always decreased from entrance to exit and at the gap center

never exceeded one-half that on the wedge at the entrance. In general, the gap heating increased with gap width and flap deflection, and rounding the gap entrance and exit lip tended to increase the overall level of heating in the gap over that for the sharp-lip configuration. Author

N69-11051# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HARMONIC VIBRATIONS OF ELASTIC PLATES IN A SUBSONIC STREAM

G. I. Kopzon 11 Sep. 1967 16 p refs Transl. into ENGLISH from Akad. SSSR. Izv. Otdeleniye Tekhnol. Nauk. Energ. i Avtomat. (Leningrad), no. 2, 1958 p 83–92

(AD-675621; FTD-HT-23-927-67) Avail: CFSTI CSCL 20/4

The article contains a purely theoretical study on harmonic vibrations of elastic airfoils in a subsonic stream of different properties. The study considers an infinite wing and, assuming it an elastic flat plate, investigates its own vibrations, taking into consideration the influence of the stream properties. An initial differential equation and derived formulas are described. The small parameter method developed by A. N. Krylov is employed throughout the study. Vibrations of a thin plate in a subsonic stream are studied utilizing the results of the work, which was also carried out by means of the above-mentioned method. Vibrations of a thin airfoil in the stream of both an ideal, noncompressible, and a compressible liquid, are investigated and relevant formulas derived. A general method is given for computing frequency of natural vibrations equally applicable to all cases. It is stated that the results obtained are readily applicable to acoustic problems, such as vibration of a thin infinite plate with periodical distribution of parameters along its length in a quiescent gas (the case of high tones) and in a liquid. One example of such a computation for each medium is given, together with the formulas employed. Author (TAB)

N69-11080# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE PROPAGATION OF GAS FLOW OUTGOING FROM A GAS TURBINE ENGINE UNDER THE MAIN ROTOR AND THE INFLUENCE OF IT ON THE STATE OF AIR AROUND A SINGLE-ROTOR HELICOPTER

L. S. Ryain 1 Apr. 1968 45 p refs Transl. into ENGLISH from the Monograph "Vertoletnye Gazoturbinnye Dvigateli" Moscow, Sb. Statei, 1966 p 112–144

(AD-675470; FTD-MT-24-31-68) Avail: CFSTI CSCL 1/3

Models of a helicopter rotor and the outlet of a gas turbine engine were used to study the propagation and washing out of gas jets beneath the rotor. Tests were also carried out directly on a helicopter, and the results are compared with those of the model tests. Discharging the gas depends greatly upon the operating conditions of the helicopter and the speed of the wind about it. The temperature fields of the air and the gas concentrations in the space below the rotor are unstable. Author (TAB)

N69-11085# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HYPERSONIC FLOW AROUND A TRIANGULAR PLATE WITH BLUNTED LEADING EDGES

V. V. Lunev 5 Jan. 1968 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. (Moscow), no. 3, 1965 p 9–16

(AD-675441; FTD-HT-23-1386-67) Avail: CFSTI CSCL 20/4

Hypersonic flow of a perfect gas with a constant adiabatic exponent past a triangular plate with a 20 degree apex angle and blunted leading edges at zero angle of attack is discussed. The simplest two-layer flow pattern is used in analysis to obtain qualitative results, giving a clear picture of interrelations among the flow parameters. Author (TAB)

N69-11116#

ANALYSIS OF PERFECT GAS FLOW AROUND ELLIPTIC CONES AT HIGH ANGLES OF ATTACK

A. P. Bazzhin et al [1968] 9 p refs Transl. into ENGLISH from Izv. Akad. SSSR, Mekh. i Gaza (Moscow), no. 4, 1968 p 45–51

Avail: CFSTI

The method of characteristics is used for analyzing hyperbolicity of the equations for depicting perfect gas flow around elliptic cones at high angles of attack. Formulas are presented for the constant velocity modulus and the constant Mach number of the transverse flow in conical shock, and computations are included that show the qualitative singularities of the flow around sharp elliptic cones at high angles of attack. About forty flow modifications were computed; and for each the following four parameters were defined: (1) angle of attack, (2) ratios of axes of elliptical cross section, (3) cone half-angle along horizontal axis of ellipse, and (4) free stream Mach number. The upper generator of the cone was always in a domain where the system of equations is elliptic; and an inner compression shock, the boundary between the upper and lower domains, originated in the upper part of the flow around a conical body at high angles of attack. Bow shock intensity was found to depend on body geometry. M.W.R.

N69-11166# Aeronautical Research Labs., Melbourne (Australia).

AN EXPERIMENTAL AND NUMERICAL STUDY OF HYPERSONIC FLOW OVER POWER-LAW BODIES

H. G. Hornung and I. A. Campbell Mar. 1968 38 p refs

(ARL/A-130) Avail: CFSTI

The hypersonic flow over axisymmetric power law bodies at zero incidence is studied in the range of powers where the asymptotic approach predicts the second order terms to be due to the body shape rather than to the entropy layer. An experimental investigation on ten models of five different powers at a free stream Mach number of 7.5 is supplemented by a numerical study using an inverse blunt body technique and the method of characteristics. Both methods were used to compare results with those of the asymptotic theory. The general behaviour of the flow fits the asymptotic theory best in an intermediate range of streamwise distance. Author

N69-11172# Goodyear Aerospace Corp., Akron, Ohio.

ESTABLISHMENT OF AN UNSYMMETRICAL WAKE TEST CAPABILITY FOR AERODYNAMIC DECELERATORS. VOLUME 3: EXPERIMENTAL WAKE SURVEY AND BODY SURFACE PRESSURE DATA

Daniel W. Henke Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Aug. 1968 353 p

(Contract AF 33(615)-3595)

(AD-675182; GER-13528, vol-3; AFFDL-TR-67-192, vol-3) Avail: CFSTI CSCL 1/3

A series of wind tunnel tests was conducted to determine pressure distribution on the surface of and in the wake of axisymmetric and asymmetric (elliptical) forebodies. These tests were conducted in support of boundary layer and wake analyses required as a basis for establishing an analytical method for predicting the drag of PARASONIC parachutes deployed in the wakes of these forebodies. The analysis of the data obtained during this test is described in Volumes I and II of the report. Tabulations of the data obtained during these tests are presented in this volume. Author (TAB)

N69-11180#

BODY OF REVOLUTION WITH MINIMUM FRONTAL DRAG COEFFICIENT AND LOW HEAT TRANSFER AT HYPERSONIC FLIGHT VELOCITIES

G. L. Grodzovskii [1968] 17 p refs Transl. into ENGLISH from Russian Presented at the 19th IAF Meeting, New York, Oct. 1968

Avail: CFSTI

On the basis of a modified Newton theory and the theory of self-similar hypersonic flows, the optimal shape of a body of

revolution with minimum frontal drag coefficient at hypersonic velocities is investigated. It is shown that the optimal-shape bodies also have a low heat-transfer coefficient, considerably less than for a conical body. It has been established experimentally that the optimal properties of the considered bodies of revolution are retained even at moderate supersonic flight velocities. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N69-10087*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DEVELOPMENT OF SONIC-BOOM SIGNATURES IN A STRATIFIED ATMOSPHERE

Reymond L. Barger Washington Nov. 1968 17 p refs
(NASA-TN-D-4890) Avail: CFSTI CSCL 01B

Equations describing the development of the pressure signature of a supersonic projectile or equivalent body of an airplane in straight steady level flight in an atmosphere having vertical gradients of temperature, pressure, and wind have been derived. The analytical method utilizes results of ray tube calculations for a stratified atmosphere in the context of an analysis by Whitham. Author

N69-10371*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLIGHT TESTS OF A DIRECT LIFT CONTROL SYSTEM DURING APPROACH AND LANDING

Joseph W. Stickle, James M. Patton, and Robert C. Henry Washington Nov. 1968 46 p refs
(NASA-TN-D-4854) Avail: CFSTI CSCL 01B

The National Aeronautics and Space Administration has recently completed a flight program to evaluate the use of direct lift control (DLC) as an aid to flight path control during approach and landing. The program utilized a U.S. Navy F8-C airplane modified to incorporate symmetrically variable ailerons to augment the primary longitudinal control system. The airplane was also equipped with an airspeed sensing autothrottle and a commercially available cross-pointer-type instrument landing system. Approximately 230 approaches were made along various single- and two-segment approach paths, guidance being provided by a modified AN/GSN-5 radar and instrument landing system data link. Comparisons of flight path deviations and touchdown dispersion between the basic F8-C control system and the direct lift control system were made. The results indicate that direct lift control provides a better control of small flight path errors than the conventional F8-C control system. Direct lift control with a controlled pitch attitude change, provided through an aileron to horizontal tail interconnect, improved piloting performance and reduced workload during the approach and landing task. Author

N69-10482*# North American Rockwell Corp., Downey, Calif. Space Div.

AIR BEARING PLATFORM, T50-2 Final Report, 1 Jul.-31 Oct. 1967

H. Fornoff 31 Oct. 1967 35 p
(Contract NAS8-20855)
(NASA-CR-97588; SD67-1163) Avail: CFSTI CSCL 01C

This report contains a brief narrative describing the T50-2 Lightweight Adjustable Air Bearing Platform and Support. The T50-2 Air Bearing Platform is designed to provide a stable base simulated near frictionless environment by means of air pads operating on a level smooth floor. It is to be used in conjunction with the NASA Serpentuator or other manual propulsion operations. The T50-2 has capability and versatility of being utilized in the studies and evaluations of docking, undocking, and other difficult simulated space maneuvers requiring simulated low friction environment through the use of air bearings. Author

N69-10496*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CALCULATED AND FLIGHT MEASURED HANDLING-QUALITIES FACTORS OF THREE SUBSONIC JET TRANSPORTS

Walter E. McNeill Washington Nov. 1968 32 p refs
(NASA-TN-D-4832) Avail: CFSTI CSCL 01D

As part of a NASA intercenter study of jet transport stability and control problems in severe turbulence, several calculated and flight-measured handling qualities factors of three current jet transports have been reviewed, and compared with various handling qualities criteria. The longitudinal and lateral handling qualities parameters were calculated by means of a digital computer program, for several typical flight conditions within the normal operating envelopes, using aerodynamic and physical data supplied by the manufacturers of the aircraft as the most reliable information available. The calculations did not take account of effects of yaw dampers and automatic pitch trim devices. On the basis of the current military specification and other published criteria, all three transports had satisfactory or acceptable predicted or flight measured longitudinal short period frequency and damping characteristics in the flight conditions of interest. Except for some cases of speed instability associated with disengagement of Mach trim compensation devices, acceptable longitudinal phugoid characteristics also were calculated for these transports. Author

N69-10681# Aeronautical Research Council (Gt. Brit.).

A PILOTED SIMULATOR STUDY OF THE TAKE-OFF MANOEUVRE OF A LARGE AIRCRAFT WITH AND WITHOUT A TAKE-OFF DIRECTOR

C. O. O'Leary and D. H. Perry 1968 44 p refs
(ARC-R+M-3524; RAE-TR-66244; ARC-28616) Avail: CFSTI

A piloted simulation of the take-off manoeuvre of a large aircraft has been developed to aid research into take-off director instruments. Records of undirected take-offs made in real flight and on the simulator have been compared, and these, as well as pilot's subjective opinions, show that the simulation was adequate for its purpose. The need for cockpit motion and visual simulation was studied briefly. Tests with one suggested form of take-off director showed that take-offs with the director were more consistent, and had increased margins of safety, compared with undirected take-offs. Author

N69-10733*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LOW SUBSONIC FLIGHT AND FORCE INVESTIGATION OF A SUPERSONIC TRANSPORT MODEL WITH A VARIABLE-SWEEP WING

Delma C. Freeman, Jr. Washington Nov. 1968 84 p refs
Film supplement number L-1008 to this report is available on loan
(NASA-TN-D-4726) Avail: CFSTI CSCL 01C

An investigation was conducted in the Langley full scale tunnel to determine the low speed static and dynamic longitudinal and lateral-directional stability characteristics of a 1/20 scale model of a variable sweep wing supersonic commercial air transport configuration. The results of the investigation showed that the dynamic longitudinal stability and control characteristics of the

model were generally satisfactory over the test angle of attack range except for the landing configuration at high angles of attack where the model was statically longitudinally unstable. The effects of power were found to be very large and stabilizing on the longitudinal stability of the model. In the wing sweep range from 20° to 42°, the model generally had good lateral-directional characteristics except for flights at the highest lift coefficients where the model diverged in yaw. The angles of attack at which these divergences occurred, were in the range where there was extensive stalling of the movable wing panels, and the airplane would not ordinarily be operated. As the sweep was increased past 42°, there was a marked deterioration in both lateral control effectiveness and Dutch roll damping, and at maximum sweep (Λ = 72°) an unstable Dutch roll oscillation together with very weak roll control made flight almost impossible. Author

N69-10935*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS OF TWIN PROPELLER DEFLECTED SLIPSTREAM STOL AIRPLANE MODEL WITH BOUNDARY LAYER CONTROL ON INVERTED V-TAIL
Richard J. Margason and Garl L. Gentry, Jr. Washington Nov. 1968 181 p refs
(NASA-TN-D-4856) Avail: CFSTI CSCL 01C

This report presents stability and control data for a small deflected-slipstream short take-off and landing (STOL) airplane model which had an inverted V-tail equipped with boundary-layer control. The results of the static wind tunnel investigation are promising and indicate that with further development, an inverted V-tail with boundary layer control can be designed which would produce the longitudinal and directional trim required for an engine-out situation with no control input by the pilot. The data also show that the lateral control required for an engine-out situation can be obtained from a spoiler with the attendant lift loss. The airplane can be trimmed with both engines operating with or without the boundary layer control on the tail when the flaps are retracted (0° flap deflection); however, when the flaps are deflected (45° flap deflection), the boundary layer control is needed to obtain trim up to a thrust coefficient of 2.10. The rudder is capable of producing large increments of yawing moment without changing directional stability and without causing cross coupling with rolling moment for both the flaps-retracted and the flaps-deflected configuration. Both flap configurations (flaps retracted and flaps deflected) with and without the boundary layer control on the tail have positive dihedral effect and are directionally stable through most of the test ranges of angles of attack and sideslip. Author

N69-10955# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THE TURBO-ELECTRIC VTOL AIRCRAFT
David W. Rabenhorst Jul. 1968 79 p refs
(Contract NOw-62-0604-c)
(AD-675332; TG-1013) Avail: CFSTI CSCL 1/3

A unique aircraft propulsive/lift power distribution system is described that promises a great deal of flexibility in the design of VTOL aircraft. Its use would permit a significant improvement in many aspects of present and future VTOL designs, including performance, safety, cost, operability, noise, applicability, and operational economy. Author (TAB)

N69-11062*# Analytical Mechanics Associates, Westbury, N. Y.
EXAMINATION OF ACCELERATED FIRST ORDER METHODS FOR AIRCRAFT FLIGHT PATH OPTIMIZATION
Henry J. Kelley and Walter F. Denham Oct. 1968 30 p refs
(Contract NAS1-7987)
(NASA-CR-66681; Rept.-68-19) Avail: CFSTI CSCL 01B

Accelerated first order optimization methods for atmospheric trajectory work are reviewed and the possibilities for extending such methods to handle constraints are examined. Difficulties arising with the gradient projection technique, in conjunction with these methods, recommend the adoption of penalty function approximation for treatment of constraints. Parameterization via spline polynomials is investigated briefly, and is found promising when used in conjunction with a time scale stretching device. Two sets of recommendations are offered for modification of a gradient projection supersonic transport trajectory optimization computer program, one a minimum revision featuring the continuous conjugate gradient algorithm, and the second a rather major revision incorporating splines, the Davidon algorithm and a difference adjoint scheme for circumventing truncation error effects. Listings summarizing program changes appropriate to these recommendations are presented. Author

N69-11199# Aeronautical Research Labs., Melbourne (Australia).
A STATISTICAL STUDY OF FLIGHT LOADS ON A CROPMASTER AGRICULTURAL AIRCRAFT
A. K. Patterson Jan. 1968 40 p refs
(ARL/SM-320) Avail: CFSTI

A statistical analysis was made of a series of load measurements for a Cropmaster agricultural aircraft, from which gust velocity and maneuver load spectra were previously obtained, to determine the accuracy of these estimates of gust velocity and maneuver load spectra. The application of the results of this analysis to further load measurements, and the relative merits of different estimators of the gust velocity and maneuver load spectra, were discussed. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and invertars. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N69-10043 Utah Univ., Salt Lake City.
INCREASING THE USEFUL LIFE OF A FUEL CELL
Sidney Henry Smith (Ph.D. Thesis) 1967 123 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-17096

Various life tests indicated that the overall life of a fuel cell was limited. It is proposed that this limitation was caused by the presence of a strong oxidizing agent produced at the anode such as the O_2H^- ion. This ion, being a powerful oxidizing agent, could attack the microscopic exposed areas of the nickel electrode and set up localized voltages. The build up of these localized voltages could result in a back emf being developed. This back emf would oppose the normal voltage of the cell and appear as a degradation in the output voltage. By reversing the gas leads of the cell, a degraded fuel cell would be restored to its full operating potential. An automatic device was developed to perform this operation. Through this device a constant output was assured, thus extending the useful life of the cell. Dissert. Abstr.

N69-10068*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND ANALYSIS OF A MODULAR SERVOAMPLIFIER FOR FAST-RESPONSE ELECTROHYDRAULIC CONTROL SYSTEMS
John R. Zeller Washington Nov. 1968 23 p refs
(NASA-TN-D-4898) Avail: CFSTI CSCL 09E

A low cost three stage servoamplifier has been developed for use in fast response research servosystems. This device has the

capability of improving the low frequency dynamics of the inductive coils of torque motor devices in electrohydraulic servovalves. In addition, this amplifier provides other servosystem functions such as summing, gain (adjustable), and compensation. A dynamic model of the amplifier–coil combination has been included to assist in analytical evaluation. The flexibility of the modular configuration has been demonstrated in several operational research installations. Author

N69-10088*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

SUMMARY OF ELECTRICAL COMPONENT DEVELOPMENT FOR A 400-HERTZ BRAYTON ENERGY CONVERSION SYSTEM

Charles S. Corcoran and Le Roy J. Yeager Washington Nov. 1968 33 p refs

(NASA-TN-D-4874) Avail: CFSTI CSCL 10B

The major electrical components of a 400 hertz Brayton cycle system are the alternator, the voltage regulator–exciter, and the parasitic loading speed controller. Unique design features of the components are described. The experimental evaluation of the components and subsystem indicates that the alternator has an efficiency of 91.5 percent at design and that the steady stage and transient performance is suitable for a space power system. In addition, bearing reactions caused by magnetic unbalance resulting from an unsymmetrical gap were determined experimentally. The data show that the reactions consist primarily of a constant and a pole frequency component. Author

N69-10121*# General Electric Co., Schenectady, N. Y. Research and Development Center.

REDUCED GRAVITY BATTERY TEST PROGRAM Quarterly Report, 21 May–20 Aug. 1968

Oct. 1968 64 p refs Prepared for JPL

(Contracts NAS7-100; JPL-952121)

(NASA-CR-97471; S-68-1140; QR-2) Avail: CFSTI CSCL 10C

This report covers the design, construction and testing of a breadboard model of test equipment capable of investigating the behavior of secondary Ag–Zn batteries in the zero-g environment of an earth orbit. Three types of test are to be performed automatically in sequence by the equipment. Included is the basic experimental work carried out to define the test procedure and equipment requirements of one of these tests which involves the photographic observation of gas bubble formation and distribution on the electrodes of a specially designed silver-zinc secondary battery during charge and discharge cycles. The cell and its peripheral equipment are described, and results are presented covering the partial discharge capacity of a porous zinc electrode as a function of the gas bubble coverage and current density. The results include: (1) Test results showing the relationship between limiting current density and discharge capacity of smooth zinc electrodes oriented horizontally and vertically in a normal gravity environment. (2) The behavior of a Yardney type HR5-DC7 silver-zinc battery during a cyclic charge-discharge test at 65% at rated capacity conducted to destroy the battery. Author

N69-10284*# Interagency Advanced Power Group, Washington, D. C.

METAL-AIR BATTERIES SYMPOSIUM COMPENDIUM OF PAPERS PRESENTED FOR PUBLICATION

Paul S. Balas 1968 32 p refs Presented at the Metal-Air Batteries Symp., Greenbelt, Md., 11 Sep. 1968 Sponsored by Electrochem. Working Group of IAPG

(Contract NSR-39-030-002)

(NASA-CR-97489; PIC-BAT-209/11) Avail: CFSTI CSCL 10C

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2. SECONDARY IRON-AIR BATTERIES O. C. Wagner (Army Electron. Labs.) p 13–15 refs (See N69-10286 01-03)
3. ZINC-AIR BATTERIES M. Sulkes (Army Electron. Labs.) p 16–19 (See N69-10287 01-03)
4. MAGNESIUM-AIR BATTERIES H. R. Knapp (Army Electron. Labs.) p 20–23 (See N69-10288 01-03)
5. LITHIUM ANODE J. Toni p 24–26 (See N69-10289 01-03)

N69-10285*# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Lab.

SECONDARY CADMIUM-AIR BATTERIES

Otto C. Wagner *In* Interagency Advanced Power Group Metal-Air Batteries Symp. Compendium of Papers Presented for Publ. 1968 p 1–12 refs (See N69-10284 01-03)

Avail: CFSTI

Sponge cadmium electrodes were developed to attain a maximum energy density from the cadmium-air system. Resultant problems included loss of capacity by the Cd-anode or fade-out, shorting due to Cd penetration, Cd poisoning of the air cathode, and water loss related to unit cadmium-air cell design. Unit cadmium-air cells were built with a cycle life of greater than 300 cycles and an energy density of between 40 to 45 watt-hr/lb. Capacity loss by the Cd anode can be prevented by a ferric oxide extender and carbon dioxide removal from the cell. The latter prevents Cd penetration, which also requires minimizing overcharge and placing an inert electrolyte absorbent interseparator between the Cd anode and main separator. A KOH electrolyte saturated with zincate can prevent air-cathode poisoning, and water loss can be compensated by providing the unit cell with an electrolyte sump. M.W.R.

N69-10286*# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Lab.

SECONDARY IRON-AIR BATTERIES

Otto C. Wagner *In* Interagency Advanced Power Group Metal-Air Batteries Symp. Compendium of Papers presented for Publ. 1968 p 13–15 refs (See N69-10284 01-03)

Avail: CFSTI

A general survey of secondary iron-air batteries concludes that problems relating to self-discharge, capacity maintenance, oxidation, and water loss must be solved before the limitations of the alkaline iron system can be overcome. These problems are discussed, and mention is made of the development of iron-air cells of 5 to 20 amp-hr capacities with life cycle greater than 200 cycles at energy densities of 60 to 70 watt-hr/lb. M.W.R.

N69-10287*# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Lab.

ZINC-AIR BATTERIES

Martin Sulkes *In* Interagency Advanced Power Group Metal-Air Batteries Symp. Compendium of Papers Presented for Publ. 1968 p 16–19 (See N69-10284 01-03)

Avail: CFSTI

Zinc-air secondary batteries appear capable of energy densities of 75 to 100 watt-hr/lb and operation of 100 or more cycles using inorganic separators. Good results are noted for zinc as the anode in primary zinc-air or zinc-oxygen batteries; and zinc electrodes up to 1/4" in thickness are operating at 80% or better of theoretical efficiency with energy densities of 80 to 150 watt-hr/lb. Zinc electrodes must be heavily amalgamated to prevent self discharge and the evolution of hydrogen, and recrystallization properties of Zn and ZnO can be a problem during long-term storage. In order for the zinc-air system to be used as a secondary battery, however, the high solubility of Zn in alkaline electrolytes must be overcome.

This high zinc solubility leads to such failure causing mechanisms as zinc electrode shape change, dendrite growth and separator penetration, and precipitation of zinc oxides in the air electrode. The air electrode for secondary zinc-air batteries appears to require the use of noble metal catalysts if auxiliary charging electrodes are to be avoided. M.W.R.

N69-10288*# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Lab.

MAGNESIUM-AIR BATTERIES

Howard R. Knapp *In* Interagency Advanced Power Group Metal-Air Batteries Symp. Compendium of Papers Presented for Publ. 1968 p 20-23 (See N69-10284 01-03)
Avail: CFSTI

Although there are difficulties involved, magnesium-air batteries can be produced with energy densities of 50 to 55 watt-hr/lb. For optimum use as the battery anode, magnesium should be used in solutions with a pH range between 6 and 9. Some measure of success was obtained using sodium chloride solutions at temperatures above freezing; although current levels were not as high as expected, voltage transients produced some difficulties, and excess water requirements caused greater battery volume and weight than originally estimated. A 3:2 eutectic of 4 N sodium-lithium perchlorate solution was found advantageous in operation to −15°F, at which temperature 33% of room temperature capacity was obtained. Room temperature capacity was only 65% coulombic efficiency of the magnesium anode because of the corrosion resulting from the chemical interaction of magnesium and water; and this reaction increased at 125°F so that only 40% of the nominal capacity was obtained. Current densities with the magnesium-air system are not as high as with zinc systems; and electrolyte weight in the former is 80 to 85% of the active materials, whereas it is 30 to 35% for the zinc. M.W.R.

N69-10289*# Interagency Advanced Power Group, Washington, D. C.

LITHIUM ANODE

J. Toni *In its* Metal-Air Batteries Symp. Compendium of Papers Presented for Publ. 1968 p 24-26 (See N69-10284 01-03)
Avail: CFSTI

Lithium can be used as an anode in a metal-air battery only if an aprotic solvent is used; and methods of electrode preparation included pressing or rolling Li ribbon onto a metal screen, pressing Li powder with or without additives onto a metal screen, or dipping Ni screen into molten lithium. Coulombic efficiencies of Li anodes have been, in general, very high; and relative high current densities have been sustained on Li electrodes. Cycling efficiency for Li electrodes in primary systems appears to be, at best, 85%; and efficiency decreases as the number of cycles increases. Secondary battery research is reported using nitrosodimethylamine as the aprotic solvent; and initial experiments using the electrolyte $PhMe_3NPF_6$-NDA indicate a 2-volt battery might be possible. M.W.R.

N69-10335* Heat Engineering and Supply Co., San Gabriel, Calif.

DESIGN AND MANUFACTURE OF PARASITIC LOAD RESISTORS FOR BRAYTON POWER CONVERSION SYSTEM Final Report

23 Jul. 1968 45 p
(Contract NAS3-10777)
(NASA-CR-72436) Avail: CFSTI CSCL 10B

Details are given on the design, manufacture and testing of Parasitic Load Resistors to dissipate 18 KWe electric power at 120 Volts and 1200 Hertz by converting the electrical energy to heat energy and radiating that energy to hard vacuum. Author

N69-10388*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

DESIGN, DEVELOPMENT AND DEMONSTRATION OF A WARM GAS DISTRIBUTION SYSTEM Final Report, Period Ending 2 Aug., 1968

12 Aug. 1968 289 p Prepared for JPL
(Contracts NAS7-100; JPL-951988)
(NASA-CR-97469; Rept.-68SD4298) Avail: CFSTI CSCL 21H

The design, development, and demonstration of a Warm Gas Distribution System (WGDS) is reported. System design, component development, system manufacturing processes and procedures, and system test results are discussed. Appendices include WGDS specifications, drawings, test plans, test data sheets, results of analyses, and other ancillary information. Author

N69-10423*# Textron Electronics, Inc., Sylmar, Calif. Heliotek Div.

DEVELOPMENT OF LITHIUM DIFFUSED RADIATION RESISTANT SOLAR CELLS

P. Payne 15 Oct. 1968 16 p Prepared for JPL
(Contracts NAS7-100; JPL-952247)
(NASA-CR-97470; QR-2; Rept.-6) Avail: CFSTI CSCL 10A

Various aspects of the lithium cell fabrication process have been investigated. These include application of the lithium by evaporation rather than by the paint-on technique; comparison of the use of an SiO layer to the use of the blue layer obtained in boron diffusion for antireflection layers; and preliminary investigation of sintering lithium cells. The third and fourth lots of lithium cells have been fabricated and delivered to JPL. Yield analyses of these cells have been made and comparison was also made to the first two lots. Author

N69-10487*# Boeing Co., Seattle, Wash. Space Div.

DEVELOPMENT AND FABRICATION OF ADVANCED BATTERY ENERGY STORAGE SYSTEM Final Report, 27 Sep. 1966-26 Oct. 1967

Sidney Gross and Henry Oman 27 Nov. 1967 134 p refs
(Contract NAS9-6470)
(NASA-CR-97621) Avail: CFSTI CSCL 10C

A silver-cadmium secondary battery energy storage system was developed to meet the power requirements of manned orbital missions of up to one year in duration. This paper describes the design and manufacture of eight of these 28-volt silver-cadmium batteries with a capacity of more than 70 ampere-hours. In addition, four charge-discharge controllers for cycling the batteries were developed, tested, and operated to assure trouble-free functioning. A detailed thermal analysis of the batteries was performed to predict accurately the heat generation and temperatures over a wide range of operating modes. Computer programs for performing the thermal analysis were developed and verified by comparison with test data. Specially designed calorimeters were used for measurements of internal heat generation in two instrumented batteries. The batteries functioned satisfactorily at each of the orbital design conditions. Life requirements were not tested. K.W.

N69-10584*# Gulton Industries, Inc., Metuchen, N. J. Research and Development Div.

AN INVESTIGATION OF THE NICKEL OXIDE ELECTRODE

S. Lerner and H. N. Seiger 2 Sep. 1968 103 p refs
(Contract NAS3-10608)
(NASA-CR-72465) Avail: CFSTI CSCL 10C

A two phase program was carried out. The first phase indicated that additions of 20 mole percent cobalt to the positive electrode significantly increased both its capacity and high temperature charge retention characteristics. The second phase concerned itself with the structural differences between ordinary nickel oxide positives and those with the 20% cobalt additions. These characteristics were studied by use of DTA and X-ray diffraction

techniques and indicated that there is a different mechanism for the conversion of β-NiOOH·20% Co to γ-NiOOH·20% Co than for β-NiOOH to γ-NiOOH. Author

N69-10585*# Tyco Labs., Inc., Waltham, Mass.
DEVELOPMENT OF CATHODIC ELECTROCATALYSTS FOR USE IN LOW TEMPERATURE HYDROGEN/OXYGEN FUEL CELLS WITH AN ALKALINE ELECTROLYTE Final Report, 1 Jul. 1965–30 Jun. 1968
J. Giner, J. Parry and L. Swette 30 Jun. 1968 281 p refs
(Contract NASw-1233)
(NASA CR-97624; Q-12) Avail: CFSTI CSCL 10A

A survey was carried out on the intrinsic activity of the transition metals, selected transition metal alloys and intermetallic compounds, and transition metal carbides, nitrides, borides and silicides for the electrochemical reduction of oxygen. Subsequently, alloy compositions known to be active were studied in detail. These included gold alloys of the precious metals and silver magnesium alloys. Measurements made on finely divided catalysts and compounds of group VIII metals prepared by the Bureau of Mines and catalysts prepared for life testing and the longevity tests are described. A co-precipitated platinum gold black was discovered which shows higher performance than platinum. The mathematical treatment of porous PTFE-bonded electrodes is given. A new model is proposed and the results indicate the possibility of very high power density electrodes. Author

N69-10708*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CALORIMETRIC, OPTICAL, AND VIBRATION INVESTIGATIONS OF STRETCH-FORMED ALUMINUM SOLAR CONCENTRATORS
Marvin D. Rhodes and Conrad M. Willis Washington Nov. 1968 45 p refs
(NASA-TN-D-4889) Avail: CFSTI CSCL 10B

Three stretch-formed aluminum solar concentrators were evaluated. The models represent three phases of a program; all were 1.52-m-diam paraboloids with a nominal rim angle of $\pi/3$ rad. Calorimetric tests were made on each model to determine the improvement in model performance caused by changes in model design and fabrication. Model 3 was superior to the other models in both geometrical accuracy and specular reflectance and is considered suitable for thermionic applications. Optical-ray-trace tests were performed on models 1 and 2 to determine the magnitude and location of surface slope errors. The largest slope errors occurred near the gore seams but the region of high error was only about 8% of the total area. Ray-trace data were also used to calculate geometric efficiency by three methods. Only the random error method gave reasonable results for both models. Vibration tests on model 1 caused failure in the welds of the rim support ring structure, but subsequent calorimetric tests revealed little or no reduction in concentrator efficiency. Author

N69-10873* General Motors, Indianapolis, Ind. Allison Div.
AXIAL FLOW COMPRESSOR COMPUTER PROGRAM FOR CALCULATING OFF-DESIGN PERFORMANCE (PROGRAM 4)
H. F. Creveling and R. H. Carmody Aug. 1968 244 p refs
(Contract NAS3-7277)
(NASA-CR-72427; EDR-5898) Avail: CFSTI CSCL 21E

The technical objectives of the contract included generating a computer (IBM 7094) programmed axial-flow compressor off-design aerodynamic performance calculation which accounts for variable specific heat and full radial equilibrium of the flow, including streamline curvature and radial gradients in total enthalpy and entropy. The resulting performance computation is iterative, with efficiencies determined from a total pressure loss coefficient which is taken as the sum of a calculated reference loss coefficient and an off-reference increment in loss coefficient. The reference loss is established through the use of correlated blade element profile loss data and the loss associated with a normal shock in the blade passage, where appropriate, for diffusion factors from 0 to 1.0 and Mach numbers from 0 to 1.6. A compressor of specified geometry is considered and energy addition for a given flow rate and rotational speed is determined through the use of blade element performance data concerning reference incidence angle and deviation angle. Tabular data for loss, incidence angle, and deviation angle are available in the program for NACA 65-series and double-circular-arc blade sections. Author

N69-11214# Babcock and Wilcox Co., Alliance, Ohio. Research and Development Div.
TUBE BEND EROSION STUDY
E. R. Michaud and J. W. Seifert 24 Jun. 1968 57 p ref
(Contract AT(11-1)-1280)
(BAW-1280-53; Rept.-5143) Avail: CFSTI

The log of operation of the once-through stream generator at the B&W Research Center was surveyed to construct an approximate history of the kind of operation the generator tubing has undergone over the past ten years. A visual and low-powered magnification examination of the internal surfaces of tube samples from the steam generator was conducted to determine the presence of steam erosion. Results of visual and low-powered magnification examination combined with thickness measurements of tube samples from the steam generator showed no evidence of internal tube erosion. NSA

N69-11230# Brookhaven National Lab., Upton, N. Y.
HYBRID FOSSIL-NUCLEAR FUELED MHD POWER CYCLES
M. Steinberg, J. Powell, M. Beller, and B. Manowitz Jun. 1968 15 p ref
(BNL-12589) Avail: CFSTI

A description is given of three alternate combination fossil nuclear fueled MHD power cycles (combination of a coal gasifier with a MHD generator): H_2-O_2, $CO-O_2$, and $CO + H_2$–air. The reforming and combustion reactions in each cycle are described, and their advantages and disadvantages are compared. Energy balances and efficiencies are given. The original conceptual cycle is described in BNL-12319-R. NSA

N69-11262# Sundstrand Corp., Rockford, Ill. Aviation Div.
ORGANIC RANKINE CYCLE TECHNOLOGY PROGRAM Quarterly Progress Report, 1 Apr.–1 Jul. 1968
R. E. Niggemann 15 Jul. 1968 109 p refs
(Contract AT(04-3)-651)
(SAN-651-65; AER-540; QPR-9) Avail: CFSTI

Activities in a program to develop a power conversion system capable of long duration operation in space are reported. Investigations are described concerning working fluids, bearings, and boilers. Author (NSA)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N69-10020 Maine Univ., Orono.
A NOVEL POLYMER SUPPORT METHOD FOR PEPTIDE SYNTHESIS
Lorrin Ray Garson (Ph.D. Thesis) 1967 117 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-2120

A method for the synthesis of peptides employs a low molecular weight polystyrene as a soluble polymer support. This synthetic technique involves (1) attachment of the N-protected C-terminal amino acid of the peptide to the polymer support by a covalent bond; (2) removal of the N-protecting moiety to produce a free amino group, (3) addition of a second N-protected amino acid to form a "peptide bond" and, after repetitive addition to obtain the desired peptide chain; (4) cleavage of the peptide from the polymer support followed by purification of the peptide. Purification after steps 1–3 is accomplished by precipitation of the substituted polymer, which is soluble in most common organic solvents, by pouring the solution of polymer and reactants into aqueous solutions. Because all the reactants, except the amino acid or peptide substituted polymer are water soluble, the former are easily separated from the polymeric material by filtration. Dissert. Abstr.

N69-10112*# Pennsylvania State Univ., University Park. Physiology Labs.

DNA-CYTOPHOTOMETRY AND HISTOLOGY OF LYMPHATIC ORGANS IN RELATION TO THE SKIN HOMOGRAFT REACTION IN HYPOXIC MICE

John M. Kmetz and Adam Anthony Sep. 1968 82 p refs
(Grants NGR-38-009-015; NIH-GM-05112)
(NASA-CR-97474) Avail: CFSTI CSCL 06P

Histologic and Feulgen-DNA cytophotometric analyses were made on lympathic organis of 132 A/J and 132 C57BL/6J strain male mice exposed to reduce barometric pressure (380 mm Hg) for one, two, or three weeks. Erythropoietic responses were assessed using hematocrit changes during the three week experimental period. Skin homografts were used as an indication of the immune potential of mice acclimated to moderate hypoxia. The major results are as follows. After three weeks of hypoxia exposure both strains of mice exhibited a decrease in the amount of functional lymphatic tissue. DNA profiles, as determined by two wavelength cytophotometry of Feulgen stained lymphatic cells, shifted in the direction of increased DNA in all cases after one week of exposure. Restoration of control profiles occurred in all three lymphatic organs by week two of exposure. Skin homografts between acclimated animals and in cases where either the donor or recipient were acclimated were retained for a longer time than skin transplants between unacclimated mice. Author

N69-10213*# Sandia Corp., Albuquerque, N. Mex. Planetary Quarantine Dept.

PLANETARY QUARANTINE PROGRAM Quarterly Report for Period Ending 30 Sep. 1968

30 Sep. 1968 22 p ref
(NASA Order R-09-019-040; NASA Order H-13245A)
(NASA-CR-97462; QR-10) Avail: CFSTI CSCL 06M

A preliminary copy of the NASA Contamination Control Handbook was reviewed for errors and correctness of technical content. Mathematical sampling models were developed to identify bacterial species and to quantitatively estimate microbial distribution on Apollo missions. To better understand the nature of particle behavior in controlled environments, three dissemination methods were designed: mechanical mixing, spinning, and acoustical generation of tagging inert particles with spores. A users' manual for the planetary quarantine lunar information system was written. Dry heat survival studies at three different temperature levels were conducted to aid in generating bioengineering parameters necessary for achieving planetary quarantine objectives. B.P.

N69-10300*# National Communicable Disease Center, Atlanta, Ga. Biophysics Section.

REDUCTION OF MICROBIAL DISSEMINATION GERMICIDAL ACTIVITY OF ETHYLENE OXIDE Summary Report

Sep. 1968 12 p
(NASA Order R-137)
(NASA-CR-97457; SR-10) Avail: CFSTI CSCL 06M

Studies dealing with the germicidal activity of ethylene oxide were concerned with effectiveness against spores of Bacillus globigii at selected concentrations and times of exposure. Comparison made of the static and dynamic chambers for use in spore exposure indicated no significant differences for periods of 2,4, and 18 hours. Details of the experimental apparatus are included, as is the procedure for taking the gas and spore samples. M.W.R.

N69-10306# Federal Aviation Administration, Washington, D. C. Office of Aviation Medicine.

ADAPTATION TO VESTIBULAR DISORIENTATION: 9: INFLUENCE OF HEAD POSITION ON THE HABITUATION OF VERTICAL NYSTAGMUS

William E. Collins Mar. 1968 9 p refs
(AM-68-2) Avail: Issuing Activity

Interactions of linear and angular accelerations indicated that the otoliths (detectors of linear acceleration) may influence responses of the semicircular canals. To obtain some clearer evidence of such possible effects, a laboratory situation was designed to provide a minimally complex test of otolith-semicircular canal interactions. Because cats show very rapid habituation of the eye-movement response to rotatory stimulation, eight such animals were repeatedly stimulated by angular accelerations. For all habituation trials, the saggital plane of the head and body of each animal was in the plane of rotation. A clear reduction of vertical nystagmus was obtained. By changing the position of the animals 180° after the adaptation trials, the same set of semicircular canals was stimulated but the orientation of the otoliths was changed. Habituation was specific to the practiced direction of nystagmus and to the practiced head (otolith) position. Author

N69-10307# National Environmental Satellite Center, Washington, D. C.

OPERATION UTILIZATION OF UPPER TROPOSPHERIC WIND ESTIMATES BASED ON METEOROLOGICAL SATELLITE PHOTOGRAPHS

Gilbert Jager, Walton A. Follansbee, and Vincent J. Oliver Oct. 1968 27 p refs
(NESCTM-8) Avail: CFSTI

A technique of estimating upper tropospheric winds over the tropics and subtropics utilizing the appearance of cirriform clouds in meteorological satellite photographs is described. Specifically, the appearance of cirrus cumulonimbogenitus, cirrus spissatus, and the edges of cirrostratus shields is used to furnish clues to the wind direction and speed in their immediate proximity. Known relationships are used to estimate large-scale wind flow at the 200 and 300 millibar levels of the atmosphere. The National Meteorological Center now routinely incorporates such wind estimates into operational numerical map analyses. The data are also transmitted in both analog and digital form to a number of weather centers for use in both conventional and numerical analyses. An objective method for verifying these wind estimates is described, and the results of a six-month test of the data are given. Author

N69-10308 Texas Technological Coll., Lubbock.

A COMPARATIVE STUDY OF SOME PHYSIOLOGICAL PARAMETERS OF STATIC AND DYNAMIC WORK PERFORMED BY THE UPPER LIMB

Jerry Lee Purswell (Ph.D. Thesis) 1967 222 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 68-2620

An attempt was made to quantitively relate static and dynamic work by using physiological measures. The basis of comparing static and dynamic work was through a static work task and a

dynamic work task each having the same static component of work. The variables of weight carried by the hand, angle of abduction and distance of reach were studied for their effect on static and dynamic work. An attempt was made to correlate the physiological response measures of work obtained from this research with some mechanical measures of work obtained by another investigator in a parallel experiment. Four subjects performed two work tasks, one static work and the other dynamic work. The dependent variables measured were increase in ventilation rate divided by body surface area, increase in heart rate, and increase in oxygen consumption divided by body surface area, all increase in oxygen consumption divided by body surface area, all measured as the increase from resting to working levels of the variable. Dissert. Abstr.

N69-10374*# Scripta Technica, Inc., Washington, D. C.
ENVIRONMENT AND BODY STATURE [LEBENSRAUM UND KOERPERGROESSE]
W. Goetsch NASA Nov. 1968 32 p refs Transl. into ENGLISH from Biol. Zentr. (Leipzig), v. 44, no. 10, 1924 p 529-560
(Contract NASw-1694)
(NASA-TT-F-11946) Avail: CFSTI CSCL 06F

Body size and growth rate of hydrae, planaria and tadpoles were examined as a function of the space and quantity of water available to each animal, attempting to exclude the effect of growth inhibiting substances (such as excreta), and equalizing feeding conditions. Several disturbing tactics were found, but no definite conclusions could be reached. Author

N69-10442*# Sandia Corp., Albuquerque, N. Mex.
AN IMPROVED MODEL OF THE VACUUM PROBE
M. E. Morris, L. W. Hughes (New Mex. Univ., Albuquerque), A. Parisi, J. W. Beakley (New Mex. Univ., Albuquerque), W. J. Whitfield et al Sep. 1968 35 p refs Supported in part by AEC
(NASA Order R-09-019-040)
(NASA-CR-97481; SC-RR-68-592) Avail: CFSTI CSCL 06M

The need for a microbiological surface sampling device with the capability for sampling large areas that are lightly loaded with microorganisms motivated the development of the vacuum probe. The intended use of the instrument is to sample clean surfaces in laminar flow clean rooms, but the device could be utilized for sampling surfaces in other clean environments. Such a device was designed, fabricated, and tested. In these tests the vacuum probe removed a mean of 89% and assayed a mean of 67% of bacterial spores approximately 1 μ in length settled on smooth surfaces which were free of viscous films. Detailed machine and assembly drawings and instructions are included. Author

N69-10444*# National Aeronautics and Space Administration, Washington, D. C.
BIOLOGY OF HARD TISSUE
Ann M. Budy, ed. 1968 399 p refs Proc. of Conf. Held at Pacific Palisades, Calif., 6-9 Mar. 1966
(NASA-SP-161) Avail: SOD $1.75; CFSTI CSCL 06C

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N69-10445*# National Aeronautics and Space Administration, Washington, D. C.
HOMEOSTASIS OF CALCIUM
In its Biol. of Hard Tissue 1968 p 13-82 (See N69-10444 01-04)
Avail: SOD $1.75; CFSTI

In the round table discussions, the remarkable constancy of the calcium level in plasma and body fluids was noted. The factors effecting the balance between calcium accretion in bone formation and calcium release from bone during osteolysis are defined as the concentrations of calcium and phosphate in blood, the presence or absence of vitamin D, the activity of the parathyroid hormone and calcitonin (or thyrocalcitonin), and diet. Several experiments showing hypercalcemic symptoms in rats fed a phosphate-deficient diet are discussed, along with the response of parathyroid animals to EDTA-induced hypocalcemia. The function of bone in calcium homeostasis is examined, and a diagrammatic model is included to show the exchange between calcium in blood and calcium on the surface of the crystals of bone mineral. A water-bridge theory is offered to explain the transit of calcium ions to and from the surfaces of individual apatite crystals in the mineralized bone matrix masses of the skeleton. Data are also presented on pH measurements of extracellular fluids, the feedback control of the uptake of alpha-aminoisobutyric acid, and the amino acid composition of thyrocalcitonin and parathyroid hormone. M.G.J.

N69-10446*# National Aeronautics and Space Administration, Washington, D. C.
LOCAL (NONHORMONAL) FACTORS CONTROLLING BONE RECONSTRUCTION
In its Biol. of Hard Tissue 1968 p 83-133 (See N69-10444 01-04)
Avail: CFSTI

As a focus for the discussions, two points are made: (1) When remodeling occurs a space is tunneled out by osteoclasts and it is only after this space is created that new haversian bone is laid down within it. (2) The localization of this space and its polarization in three dimensions are obviously not controlled by hormones. In this context the results obtained from calcium kinetic studies performed on patients with rheumatoid arthritis are examined. Animal experiments, involving calcium content of the bones and measurements of the uptake of radioactive calcium given at varying periods prior to sacrifice, are also discussed. Metabolic data on marrow and bone cells derived from the same bone sample are presented. The formation of haversian systems is discussed in relation to bone remodeling, and the organs used for homeostasis of calcium ion from the lowest to the highest vertebrates are listed. M.G.J.

N69-10447*# National Aeronautics and Space Administration, Washington, D. C.
CELLULAR DIFFERENTIATION IN BONE
In its Biol. of Hard Tissue 1968 p 135-204 (See N69-10444 01-04)
Avail: SOD $1.75; CFSTI

Four kinds of activity in the cellular differentiation of bone are discussed: bone cell population studies on the whole population; individual cell studies; the static attributes of the population; and the dynamic aspect of differentiation, involving the ideas of the homogeneous becoming heterogeneous, and the transformation of one mode into another mode without it necessarily being part of an ontologic process. The concept of bone cell population is discussed in relation to the great variation in local populations in different parts of a bone, in different bones, at different ages, in different species, and in different functional states. Criteria for identifying cell types and giving them names are assessed, along with the problem of tracing individual cell lineages through serial mitoses and isolation. Consideration is also given to the controlling

mechanisms, such as induction and hormone action, the action of the vascular system on the cell population, and the effects of mechanical, nutritional, and nervous influences. M.G.J.

N69-10448*# National Aeronautics and Space Administration, Washington, D. C.
SYSTEM DISEASES OF BONE
In its Biol. of Hard Tissue 1968 p 205–254 (See N69-10444 01-04)
Avail: SOD $1.75; CFSTI

From the viewpoint of cell or tissue biology, bone disease is described in terms of the derangement of the accretion and resorption processes and the balance between them. The discussion centers around matrix because it appears as the primary material which determines form; the chemical characteristics of the matrix, once they have been laid down, serve to attract the necessary mineral to provide rigidity. It is pointed out that although mineral metabolism may affect the processes of resorption and secretion of matrix in some situations, in general it tends to be a follower rather than a leader. Bone cell metabolic systems are discussed in relation to where controls for each overall process may be applied. Bone diseases are classified according to three kinds of disturbances that can occur: (1) defects in cellular machinery, (2) a deficiency in the availability of raw materials, or (3) a disturbance in the controls that regulate the rates of one or more steps, such as hormonal, local, or informational. Data obtained from biopsies and autopsies are assessed. M.G.J.

N69-10449*# National Aeronautics and Space Administration, Washington, D. C.
GENERAL SESSION 1
In its Biol. of Hard Tissue 1968 p 255–326 (See N69-10444 01-04)
Avail: CFSTI

To show the effect of parathyroid extract in the rat, photomicrographs are included to illustrate sections of bones taken from rats that received 1000 units of parathyroid extract. Evidence for possible parathyroid involvement in control of hypercalcemia is presented, and studies on dietary factors in homeostasis are discussed. Data are given on the pattern of RNA synthesis in vivo in the different cells of bone obtained by autoradiographic techniques, and on a system developed for studying the epiphyseal plate cartilage with respect to a fluid phase aspirated from the cartilage. Also considered are local factors involved in remodeling, such as how the bone adapts itself by growth, external remodeling, and response to unbalanced stresses that may fall on it. M.G.J.

N69-10450*# National Aeronautics and Space Administration, Washington, D. C.
GENERAL SESSION 2
In its Biol. of Hard Tissue 1968 p 327–357 (See N69-10444 01-04)
Avail: SOD $1.75; CFSTI

The factors governing cellular differentiation in bone are reviewed, and the need to define the relationship of mitosis to induction is stressed. The possibilities of analyzing the action of tetracyclines on calcification in vitro are discussed, and the factors which exercise a major influence on test results are examined. Summary data are presented to indicate the kinds of information which can and cannot be expected from tissue-culture studies. Figures are included to show the total incorporation of tetracycline into embryonic bone rudiments as a function of time, and the dependence of tetracycline concentration on the incorporation of radiocalcium in embryonic ulna. Also discussed are experiments designed to demonstrate the importance of thyrocalcitonin in the responses of a rat to an excess of administered parathyroid hormone; a rat perfusion system was employed. Techniques for isolating and separating lipids are discussed in relation to a method for studying the possible mechanism of hormone action at the level of the cell membranes. An example of a neutral induction system is given, along with experimental findings on the chemical aspects of decalcified bone-matrix implants. M.G.J.

N69-10463*# California Univ., Berkeley. Dept. of Nutritional Sciences.
NUTRITIONAL REQUIREMENTS AND BREEDING BEHAVIOR OF PEROGNATHUS Final Report, 1 Jan.–1 Sep. 1968
Rosemarie Ostwald [1968] 14 p
(Grant NGR-05-003-118)
(NASA-CR-97574) Avail: CFSTI CSCL 06A

A semi-purified synthetic diet was found to maintain body weight, organ weights, and hematological parameters in Perognathus longimembris at the same levels as for a group of animals fed a mixed seed diet. The synthetic diet appeared to increase body fat of males but not of females. Photoperiods of 10 and 16 hr did not suppress spontaneous or induced estrus for at least 7 to 9 mos, although photoperiods did produce a lengthening of the time between estrus and permitted onset and cessation of estrus irrespective of the natural season of Perognathus Pe. M.W.R.

N69-10498# Oak Ridge National Lab., Tenn.
DEPTH DOSES OF FISSION NEUTRONS IN TISSUE-EQUIVALENT MATERIAL
Lubomir David [1968] 12 p refs Transl. into ENGLISH from Jad. Energ., no. 13, 1967 p 241–245
(ORNL-tr-1963) Avail: CFSTI

Accurate knowledge of fluence-dose relation is needed in neutron monitoring for radiological protection. In this paper, fluence-dose conversion factors for the depths of 0, 5, 10, 20, and 30 cm in an infinite slab of tissue equivalent material are given and their dependence on neutron energy over the range 0.1 keV to 10 MeV is determined. In addition, average values of these conversion factors for fission neutron spectrum as a function of its threshold energy are calculated and intercomparisons of several activation integrators as to their efficiency of measuring fast neutron tissue-doses are discussed. Author (NSA)

N69-10604*# California Univ., Berkeley. Space Sciences Lab.
INTERDISCIPLINARY RESEARCH IN THE PHYSICAL, BIOLOGICAL, ENGINEERING, and SOCIAL SCIENCES Annual Report, 1 Oct. 1967–30 Sep. 1968
Samuel Silver 30 Sep. 1968 120 p refs *Its* Seri. 9, Issue 60
(Grant NsG-243)
(NASA-CR-97589) Avail: CFSTI CSCL 06

Interdisciplinary scientific research at a university is summarized under the major headings of core funding, social sciences, and nutritional sciences. The core funding component comprises activities in atmospheric and space physics, atomic physics, astronomy, biosciences, engineering science, public administration, and technology and urban management. Mention is made of a new careers program, faculty and student support in new programs, and seminars. Applications of system analysis, specific projects, a seminar, and the relation of the social science group to the external environment are reviewed. Nutritional studies dealt with maximum protein tolerance in man as well as other activities. Purposes, findings, and personnel are noted for each of the research projects. M.W.R.

N69-10628# National Research Council of Canada, Ottawa (Ontario).
THE EFFECTS OF PSYCHOLOGICAL STRESS UPON DECISION PROCESSES AND THE SPEED AND PRECISION OF TRACKING MOVEMENTS. 1: A STUDY OF THE EFFECTS OF SLEEP DEPRIVATION AND DISTURBANCE

C. B. Gibbs, R. Leonardo, and G. F. Rowlands Jul. 1968 35 p refs
(NRC-10397; ML-2) Avail: CFSTI

Twelve youths were deprived of sleep for 48 hours. Each subject was tested for 15 minutes at four-hourly intervals, on each of two tasks: (a) of mirror tracing and (b) of step-input tracking, using an instrument named the stressalyzer. The same subjects were again tested one week later. They were then allowed to sleep whenever they wished, but were aroused at four-hourly intervals in the night, some 15 minutes before the times, near 1:00 a.m. and 5:00 a.m., at which they were tested during the previous study of complete sleep deprivation. The subjects' scores on the stressalyzer were compared, at the same stage of testing, in the two conditions of sleep deprivation and disturbed sleep. Sleep deprivation of 48 hours produced little or no deterioration in the group's performance in mirror tracing, but tracking ability on the stressalyzer deteriorated sharply after 20 hours without sleep, with a further large decrease in skill at the 36-hour stage of testing. In some subjects, disturbance of sleep produced far more impairment than complete loss of sleep, at the same stage in testing. Author

N69-10567*# Texas Univ., Houston. Graduate School of Biomedical Sciences.
DEVELOPMENT OF COMPUTER TECHNOLOGY FOR MEDICAL DATA ANALYSIS TO BE APPLIED TO APOLLO AND FOLLOW-ON SPACE MISSIONS Final Report
Aug. 1968 215 p refs
(Contract NAS9-7029)
(NASA-CR-92377) Avail: CFSTI CSCL 06S

An overview is presented on the work undertaken to integrate experimental and ground-based medical data collection and analysis schemes into the medical data processing needs and capabilities of Project Apollo and follow-on space missions. Detailed data are provided on the design, construction, and preliminary evaluation of a system for automatic measurement and real-time digital display of systolic and diastolic blood pressures. The system uses analog and digital techniques in data processing and decision making. Comparisons are drawn between parametric and nonparametric analyses of bed rest data with respect to computing time, assumptions and restrictions of the statistical model, degree of sophistication in the analysis, and power of the statistical tests. Also described is a system designed to investigate the relationships that may exist between physiological variables and the depth of sleep. This involved the development of analog computer circuitry for preprocessing electrocardiogram and respiration signals in order to provide several characteristics of the cardiovascular and respiratory system pertinent to the depth of sleep. M.G.J.

N69-10660# Joint Publications Research Service, Washington, D. C.
AUTOMATIC RECOGNITION OF HEART RHYTHM DISORDERS MANIFESTED BY VARIATIONS OF THE RR AND PR INTERVALS OF THE EGG
I. D. Pupko et al. 1 Nov. 1968 10 p refs Transl. into ENGLISH from Med. Tekhn. (Moscow), no. 4, 1967 p 7-13
(JPRS-46790) Avail: CFSTI

Methods and equipment for automatic analysis of RR interval stability and length during ECG tracings are evaluated. An algorithm for calculating the stability of the RR interval is formed on the basis of the constantly estimated difference between two adjacent RR intervals. The developed equipment signals the presence of pathology in cases where the RR interval is less than 600 msec or above 1200 msec or the difference in the length of adjacent RR intervals exceeds 280 msec. It also permits estimating the length of the RR interval to discover tachycardia and bradycardia. A block diagram for the apparatus is included. G.G.

N69-10687*# Naval Aerospace Medical Inst., Pensacola, Fla.
LABYRINTHINE DEFECTS AS SHOWN BY ATAXIA AND CALORIC TESTS
Alfred R. Fregly and Ashton Graybiel 22 Aug. 1968 20 p refs
(NASA Order R-93; Proj. MR005.04-0021.144)
(NASA-CR-97463; NAMI-994) Avail: CFSTI CSCL 06S

Groups of individuals with various loss or disturbance of labyrinthine function (N = 49) and patients who had vertigo as a major symptom or complaint (N = 76) were very different from a control group of normals (N = 240) in the frequency with which their ataxia test battery performance scores and threshold caloric test responses fell within the lowest 5 percent of the normative distributions. Generally, caloric test results could be predicted from ataxia test results better than results of ataxia tests from those of caloric tests in the various groups. In those individuals with total or near total loss of labyrinthine function all test findings were in perfect or near perfect agreement in relation to the 5th percentile cut-off criterion employed. Author

N69-10691*# Techtran Corp., Glen Burnie, Md.
THE INITIAL GROWTH CYCLE OF THE RANA TEMPORARIA TADPOLE [LE PREMIER CYCLE DE CROISSANCE DU TETARD DE RANA TEMPORARIA]
E. Faure-Fremiet and J. Dragoiu Washington NASA Oct. 1968 30 p refs Transl. into ENGLISH from Arch. Intern. Physiol. (Liege), v. 21, May/Oct. 1923 p 403-437
(Contract NASw-1695)
(NASA-TT-F-11948) Avail: CFSTI CSCL 06C

Attempts to determine the variations in the embryonic system between the initial and second stages of development and between the second and third stages in the development of frog eggs are detailed. In order to eliminate the difficulty resulting from the presence of the mucin bag surrounding the egg at the time of its laying in weight comparisons, the eggs were weighed and released free in the general cavity just before penetration into the uterine tubes. Then the tadpoles were weighed in stage 2 after they had separated from the mucilaginous ganglia. The frog egg is considered a closed system from the energy point of view, with protoplasmic mass quite small in comparison to reserves. During transformation from initial to second stage (tadpole at birth) a loss of energy of 1.952 calories is noted, followed by an increase in weight of no more than 10% and a loss in dry weight corresponding to combustion of some fats, glycogen and nitrogenized reserves. The transformation of the system between stages 2 and 3, marking the end of the autotrophic growth cycle corresponds to a loss of 3.306 calories and an increase in weight of 312%. The weight increase results from water absorption. Author

N69-10751*# General Technical Servies, Inc., Upper Darby, Pa.
A STUDY OF THE GENERAL DYNAMICS OF THE PHYSICAL-CHEMICAL SYSTEMS IN MAMMALS Final Report
Arthur S. Iberall 1968 31 p refs
(Contract NASw-1066)
(NASA-CR-97663) Avail: CFSTI CSCL 06A

Summarized are results of the dynamics of mammalian bio-systems which were undertaken in an attempt to explain: (1) temperature regulation starting at the level of the microcirculation where the monitoring of oxygen supplies to tissue and the governing of heat production takes place; (2) overall control and transmission characteristics in the cardiovascular system; (3) hormonal regulation through interactions of the products of the endocrine system with regulated parameters and blood constituents; and (4) the behavioral system for consistency of orienting physical views of the dynamics of a complex computer control network with psychological and physiological overtones. A new definition of life was made in an attempt to guide the physical search for explanations of the operation of the biological system; and to bring the physical scientist close to a physical base from which he could model, build, or

assess systems that resemble naturally living systems by suitable operational definitions. Applications of dynamic analyses of biological systems to practical problems of monitoring and clinical diagnosis, as for example, the use of the concepts in the spectral analyzer approach to analysis of living systems are discussed; and potential applications for specific NASA studies of extra-terrestrial life are indicated. S.C.W.

N69-10786# Japan Atomic Energy Research Inst., Tokyo.
SURVEY OF THE LITERATURE ON THE CHARACTERISTICS OF AIR SAMPLING FILTER PAPER
Yoshikazu Yoshida and Yoshio Ikezawa Jun. 1968 29 p refs In JAPANESE
(JAERI-4046) Avail: Issuing Activity

The important characteristics of air sampling filters are collection efficiency, flow resistance and surface collection efficiency These characteristics depend not only on the kind of filter medium, but also on the properties of an aerosol for sampling, and on the sampling conditions. A survey was made of the literature for air sampling filters used in operational health physics, and the important data are given. Author

N69-10950# Milan Univ. (Italy). Istituto di Scienze Botaniche.
THE SYNTHESIS OF 3 PGA-1-C-14 AND DIHYDROXYACETONE-PHOSPHATE-1-C-14 FOR THE PREPARATION OF GLUCOSE-3-C-14 AND GLUCOSE-4-C-14 [SINTESI DELL'ACIDO 3-FOSFOGLICERICO-1-C-14 E DI DEIDROSSIACETONFOSFATO-1-C-14 AI FINI DELLA PREPARAZIONIE DI GLUCOSIO-3-C-14 E DI GLUCOSIO-4-C-14]
E. Sturani 1968 19 p In ITALIAN; ENGLISH summary
(Contract EURATOM-083-64-11 RISI)
(EUR-4044i) Avail: CFSTI

High specific activity 3 PGA-1-^{14}C obtained by means of the ribulose diphosphate carboxylase reaction is used for the preparation of DHAP-1-^{14}C and fructose-3-^{14}C with the aid of the following enzymes: 3 PGA kinase, GAP dehydrogenase and triosephosphate isomerase. The fructose 3-^{14}C, which is obtained from FDP by the action of acidic phosphase, is transformed into glucose-3-^{14}C in the presence of hexokinase and phosphoisomerase. Author

N69-10967# Japan Atomic Energy Research Inst., Tokyo.
SURFACE CHEMICAL STUDIES ON RADIOACTIVE CONTAMINATION AND DECONTAMINATION OF SOLID SURFACES
Yoshiki Wadachi 1968 35 p refs In JAPANESE; ENGLISH summary
(JAERI-1165) Avail: CFSTI

The mechanisms of RI aqueous solution contamination and its decontamination of solid surfaces were studied surface chemically. Solid surfaces were classified into permeable (cotton cloth) and impermeable (metal, paint, plastic) surfaces, concerning RI aqueous contamination, and the mechanisms of contamination were classified considering also their decontamination. The mechanisms of decontamination were classified according to the actions of decontaminants. Based on these classifications, the mechanisms of solid surface radioactive contamination and decontamination were studied systematically by means of the washing of RI contaminated surfaces with water, surfactants and decontaminants. In addition, studies were carried out on the mechanisms of the contamination and decontamination of solid surface (active carbon powder) which is difficult to classify into permeable or impermeable surface. Author

N69-10970*# Howard Univ., Washington, D. C. Dept. of Physiology.
NEUROHUMORAL CONTROL SYSTEMS OPERATION IN ADJUSTMENT OF VENTRICULAR PERFORMANCE Semiannual Technical Report, Period Ending 14 Jul. 1968
Edward Wm. Hawthorne Oct. 1968 12 p
(Grant NGL-09-011-017)
(NASA-CR-97625) Avail: CFSTI CSCL 06C

Results of studies on the effects of carotid sinus hypotension on cardiac function and aortic pressure in awake, intact dogs are reported. Dogs were instrumented for study using cuffs and measurements were made of the simultaneous changes occurring in brachiocephalic artery pressure (above the point of cuff constriction), aortic pressure, ventricular pressure, and left ventricular external circumference changes. The left subclavian was ligated so that all head pressure and blood flow was via the brachiocephalic artery. Primary results of these preliminary experiments are as follows: (1) a significant fall in head pressure and therefore carotid sinus pressure bilaterally can be easily produced by temporarily occluding a cuff placed about the brachiocephalic artery in awake instrumented dogs that have left subclavian artery ligation; (2) carotid sinus hypotension induced in awake dogs well past their recuperative period following surgery for instrumentation can be carried out without pain or discomfort to the animal; (3) sudden and temporary carotid sinus hypotension in awake dogs typically increases heart rate, aortic pressure, left ventricular end-diastolic pressure and heart size, both end-diastolic and end-systolic; (4) in awake dogs with complete beta adrenergic receptor blockade after propanolol infusion, temporary carotid sinus hypotension caused a reversal of the bradycardia induced by phenylephrine infusion; and (5) carotid sinus hypotension can increase heart rate significantly by either inhibiting cardiac vagal activity or by increasing sympathetic activity, or both. S. C. W.

N69-10981*# Aztec School of Languages, Inc., Acton, Mass.
MORPHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS OF FERN PROTHALLIA [MORPHOLOGISCHE UND PHYSIOLOGISCHE UNTERSUCHUNGEN AN FARNPROTHALLIEN]
Reinhard Orth Washington NASA Nov. 1968 50 p refs Transl. into ENGLISH from Planta (Berlin), v. 25, 1936 p 104–150
(Contract NASw-1692)
(NASA-TT-F-11970) Avail: CFSTI CSCL 06C

The spores of homosporous ferns are found to be pigmented yellow or green by the same pigments as occur in the leaves. The tentative results of quantitative analyses for cholorophyll, carotin, carotinoids, and xanthophyll are reported. On the basis of morphogenetic and morphological investigations, the need for a clear distinction between protonema and prothallium is demonstrated and taxonomical inferences are advanced. A morphogenetic sequence is derived from a classification by prothallium geometries starting with *Trichomanes* and ending with *Osmunda*. Author

N69-11056*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A MICRO LAGOON TECHNIQUE FOR THE CULTURE AND OBSERVATION OF ISOLATED MAMMALIAN CELLS
Clarence D. Cone, Jr. and Kathryn M. Peddrew Washington Nov. 1968 28 p refs
(NASA-TN-D-4906) Avail: CFSTI CSCL 06A

A technique for physically partitioning a monolayer of cells into micro regions on a culturing surface is described. The method consists of forming a thin grease layer into a field of tiny ponds or lagoons in which small numbers of cells or other microbiological specimens can be confined for purposes of growth, manipulation, and microscopic observation. Special instruments and procedures which have been developed for lagoon-field formation are described in detail, as are the characteristics of various formation materials which have been evaluated. Factors and problems affecting various aspects of lagoon-field suitability for cytological purposes are discussed, and the details of special culturing vessels and lagoon-inoculation procedures which have been developed by the authors for particular types of experiments are presented. A number of cytological applications, particularly in the field of time-lapse cinephotography, in which the technique has proven to be exceptionally valuable are outlined. The basic micro lagooning

techniques described have considerable flexibility for adaptation and should thus prove to be useful for a wide range of cytological applications where simple micro isolation is a prime requirement. Author

N69-11098# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
INDUCED RADIONUCLIDES IN ASTRONAUTS Quarterly Activity Report, 1 Jan.–1 Apr. 1968
R. L. Brodzinski, N. A. Wogman, and R. W. Perkins 17 Apr. 1968 32 p refs
(Contract AT(45-1)-1830)
(BNWL-531-3) Avail: CFSTI

The absolute and relative production rates of ^{7}Be, ^{22}Na, and ^{24}Na were measured in tissue and tissue equivalent solutions exposed to high energy proton beams. The production rate of ^{7}Be was shown to be in reasonably good agreement with calculated production rates based on cross sections. The induced ^{7}Be as a function of radiation dose and energy were also in good agreement with the theoretical values. Of particular significance in this work, was the observation that the ratio of ^{7}Be to ^{24}Na increased smoothly as a function of increasing proton energy. The ratio of these radionuclides, therefore, allows one to determine the effective bombarding energy of the protons. Once this energy is known the irradiation dose can be determined directly from the experimental and theoretical curves that define activity per unit dose as a function of energy. The second significant observation was the high levels of ^{11}C produced in human patients on proton bombardment. Author (NSA)

N69-11135
BIOLOGICAL INVESTIGATIONS IN SPACE
O. Gazenko et al [1968] 4 p Transl. into ENGLISH from Pravda (Moscow), no. 320(18367), 15 Nov. 1968 3 p
Avail: CFSTI

Biological experiments conducted by the Zond 5 lunar probe and during other space missions as well as laboratory studies simulating space flight conditions are summarized in terms of some accomplishments and their possible significance. Mention is made of difficulties in simulating prolonged weightlessness and the continuous study of the effects of cosmic radiation. Changes in hereditary structures of some lower forms of life are noted, as in the experiment with lysogenic bacteria aboard Zond 5. M.W.R.

N69-11170# Los Alamos Scientific Lab., N. Mex.
AIR SAMPLING WITH PLASTIC BAGS
B. C. Eutsler and E. E. Campbell [1968] 9 p refs Presented at Am. Ind. Hyg. Assoc. of the Rocky Mt. Sect., Albuquerque, N. Mex.
(LA-DC-9056; CONF-670937-3) Avail: CFSTI

The use of plastic bags for in-plant air sampling is investigated. Mylar bags which hold approximately 14 liters were tested. The bags were filled with air and then injected with the contaminant to be tested. The air sample was then transferred to an infrared cell or gas chromatograph and tested. Test results, including storage losses, for various compounds are presented. NSA

N69-11189# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aerospace Medical Research Labs.
HUMAN EQUILIBRIUM DURING ACOUSTIC STIMULATION BY DISCRETE FREQUENCIES Final Report, Nov. 1966–Feb. 1967
C. Stanley Harris and Henry C. Sommer May 1968 18 p refs
(AD-675172; AMRL-TR-68-7) Avail: CFSTI CSCL 6/19

The ability of subjects to balance on narrow rails was measured during exposure to pure tones of 100, 260, 590, 1500, and 2500 Hz and a control condition. One group of subjects was presented the test stimulus at intensity levels of 95 dB (re 0.0002 dyne/sq cm) in the left ear and 75 dB in the right ear (asymmetrical exposure). The other group was presented the tones at a level of 95 dB in both ears (symmetrical exposure). A decrement in rail performance occurred at 1500 Hz for the asymmetrical exposure group and at 590 Hz for the symmetrical exposure group. The decrement determined with symmetrical exposure was less than the decrement found with asymmetrical exposure. Author (TAB)

N69-11207# Wisconsin Univ., Madison. Dept. of Radiology.
CONSTRUCTION OF AN I-125 PHOTON SOURCE USING AN IMPROVED SOURCE HOLDER
R. M. Witt, J. A. Sorenson, and J. R. Cameron 22 Jul. 1968 6 p refs
(Contract AT(11-1)-1422)
(COO-1422-36) Avail: CFSTI

The procedure used to construct an ^{125}I photon source for bone mineral scanning is described. The anion exchange technique is used. Details on the design and materials of the special ^{125}I resin bead source holder are given. NSA

N69-11228# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHYSIOLOGICAL ASPECTS OF WEIGHTLESSNESS
I. I. Kas'yan and V. I. Kopanev 29 Mar. 1968 27 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow)
(AD-675455; FTD-MT-24-36-68) Avail: CFSTI CSCL 6/19

A comprehensive review of literature published in 1964 and 1965 on all aspects of the physiological effects of weightlessness, particularly during manned space flight, is presented. Results of Soviet research in the area are emphasized, though reference is made to American data as well. The most significant works are summarized briefly and concisely and appropriate graphics are included. A bibliography of Soviet and Western references is provided. TAB

N69-11235# Oklahoma Univ., Norman.
FAST NEUTRON DOSIMETRY OF CF-252
George Davis Oliver, Jr. (Ph.D. Thesis) 1968 75 p refs Supported by AEC
(TID-24609) Avail: CFSTI

An investigation of the fast neutron dose rate in millirad per hour around a linear californium-252 source in a simulated tissue environment using a practical dosimetry system is described. Two methods of measurement were used to determine the dose rate decrease with increasing tissue depth: silicon diode dosimeters and activation threshold foils. Also, the diode dosimeters were used to measure the fast neutron dose distribution in a single plane around the californium-252 source. Based on this distribution, an isodose chart was established. This investigation is aimed toward the practical use of californium-252 for radiotherapy. NSA

N69-11254# RAND Corp., Santa Monica, Calif.
NEW DIRECTIONS IN ORGANIZATION THEORY
Timothy Hallinan Sep. 1968 15 p refs
(AD-675167; P-3936) Avail: CFSTI CSCL 5/1

A summary is given of the historical development of organization theory. Organization theory draws heavily on many fields: psychology, sociology, anthropology, industrial management, business and public administration, economics and political science, among others. Five schools or approaches were identified within the field. They are: closed system or machine model derived from administrative management; relationship of morale to productivity; internal dynamics of organizational behavior; open ended system of informal organizations; and organization in its environment as a unit of observation and analysis. B.P.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N69-10031 Connecticut Univ., Storrs.
A STOCHASTIC MODEL OF THE HUMAN OBSERVER AS A DETECTOR OF SIGNALS EMBEDDED IN NOISE
Robert Michael Glorioso (Ph.D. Thesis) 1967 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-1346

A functional model of the human operator in a Dynamic, Alerted-Operator, Discrete, Visual Signal Detection task where the signal-to-noise ratio is quasi-stationary combines concepts of threshold training and learning without a teacher to describe operator decision behavior. Three experiments and a digital computer simulation verify the model and find equivalent operator parameters with respect to the model. Functional modeling of operator cognitive processes was found to be feasible. The human operator can be trained to use different equivalent decision thresholds as a function of signal-to-noise ratio. The operator's decision process is equivalent to decreasing the signal-to-noise ratio of a noiseless decision process by 1.6dB. The operator can be trained to classify four distributions in a near optimum manner and equivalent classification boundaries can be found. Equivalent operator decision thresholds and signal classification boundaries are affected little by the presence or absence of feedback. If the signal-to-noise ratio is quasi-stationary, the operator can recognize a change in signal-to-noise ratio and he uses four of five of the past observations as well as the present observation to estimate the system's apparent signal-to-noise ratio.
Dissert. Abstr.

N69-10147 Texas Technological Coll., Lubbock.
THE QUANTIFICATION OF HUMAN EFFORT AND MOTION FOR THE UPPER LIMBS BY MEANS OF AN EXOSKELETAL KINEMATOMETER
Jerry D. Ramsey (Ph.D. Thesis) 1967 318 p
Avail: Univ. Microfilms: HC $14.40/Microfilm $4.10 Order No. 68-2621

A device for monitoring the kinematic motion of the upper limbs, the Exoskeletal Kinematometer, was developed to provide instantaneous angular displacement data. This device consists of a shoulder mount, two arm mounts upon which are fastened linkages that follow the arm movement, and potentiometers which measure the angular displacement of the joints of rotation. The angular displacement data serves as input to a series of computational procedures which were developed to evaluate various mechanical measures of human effort. The specific measures of interest were: the velocity and acceleration at the center of mass of each arm segment, the changes in mechanical energy of the entire arm system, the force and torque at each arm joint, and the linear and angular impulse at each arm joint. In addition to assessing the characteristics of the mechanical indices, these measures were correlated with the physiological measures of the same task. The correlations between the mechanical and physiological measures of the task substantiate that total and shoulder angular impulse, shoulder torque, and total mechanical energy are the better of the mechanical indices of human effort.
Dissert. Abstr.

N69-10273*# Environmental Research Associates, Randallstown, Md.
STUDY OF THE ASTRONAUT'S CAPABILITIES TO MAINTAIN LIFE SUPPORT SYSTEMS AND CABIN HABITABILITY IN WEIGHTLESS CONDITIONS. MOD 3. A NEW TECHNIQUE FOR INVESTIGATING CARGO TRANSFER IN SIMULATED WEIGHTLESS ENVIRONMENTS
Harry L. Loats, Jr. and G. Samuel Mattingly [1968] 33 p
(Contract NAS1-7887)
(NASA-CR-66708; ERA-68-2) Avail: CFSTI CSCL 22A

The technique utilizes the water immersion simulation technique validated by Environmental Research Associates in the Gemini extravehicular simulation program to provide a neutrally buoyant medium for the subject. A series of 18 evaluation runs was performed on the final version of the simulator, comprising 3 cargo package configurations and 3 package masses. A continuous 16 mm motion picture record at 24 fps was made to provide evaluation data. The cargo variations included package masses of 2, 6, and 10 slugs and cubical packages of 12, 17, and 21 in. linear dimension. Two series of 9 runs were accomplished to determine learning characteristics.
Author

N69-10622# European Atomic Energy Community, Ispra (Italy). Directorate for Health and Safety.
SAFETY PROBLEMS [I PROBLEMI DELLA SICUREZZA]
E. Jacchia 1968 8 p In ITALIAN; ENGLISH summary Presented at Le Technologie Avanzate ed il Progr. Econ., Bologna, Italy Dec. 1–2, 1967
(EUR-3911i) Avail: CFSTI

Unlike the nuclear sector, which presents special safety problems, the new technologies do not appear to offer special safety problems. Neither electronics nor automation (with the possible exception of some psychological or social aspects) present for the workers or the population risks of a nature specifically different from those known in conventional activities. This is true also for the space sciences, with the exception of certain hazards of a ballistic nature or the hypothetical risks of a contamination of the environment in which we live. At the same time technological development and economic progress entail the gradual diffusion into the environment of a quantity of pathogenic chemical and physical agents which constitute a potential danger not only for present but also for future generations (genetic effects). An intensive study of the mutagenic effects on mammals and in particular on man has been effected only for ionizing radiations, whereas hardly anything is known of the mutagenic effects of the other physical and chemical agents on man; geneticists therefore cannot exclude the possibility that they may be significant. A vast field of research is thus open.
Author

N69-10626*# AiResearch Mfg. Co., Los Angeles, Calif. Dept. of Life Sciences.
OBSERVATIONS ON LUNAR GRAVITY SIMULATION
W. G. Robertson and E. C. Wortz 30 Oct. 1968 29 p refs
(Contract NAS9-6481)
(NASA-CR-92375; LS-68-4390) Avail: CFSTI CSCL 06K

Experiments were conducted to evaluate and compare the metabolic costs of performing upper- and lower-torso work in a G-2C pressure suit and to evaluate 1/6-g six-degree-of-freedom simulators based on the metabolic costs of the exercise. Tests were performed at 1 g and at 1/6 g using a counter-balance vertical suspension simulator. Metabolic rates and other physiologic costs of self-locomotion were evaluated at 1/6 g using six subjects wearing pressurized Gemini pressure suits. The physiologic costs of upper-torso work were evaluated in both a 1 g and 1/6-g environment. Results show that metabolic rates measured at 1/6 g are significantly increased with velocity. Energy costs for carrying a 75-lb earth-equivalent-weight pack at 1/6 g increased when compared to costs obtained without additional weight; this increase approached significance. When data were normalized for the subject's lunar weight, it appeared that the subject did not perform as efficiently in simulated lunar gravity as in a 1 g environment. No significant differences were observed between metabolic cost of performing at 1 g and at 1/6 g or between different modes of accomplishing the tasks.
Author

N69-10645*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF PASSIVE TEMPERATURE AND HUMIDITY CONTROL SYSTEMS FOR ADVANCED SPACE SUITS Materials Research Report, 1 Jul. 1967–1 Sep. 1968
W. Woo Nov. 1968 72 p refs
(Contract NAS2-3817)
(NASA-CR-73271; TRW-06462-6007-R000) Avail: CFSTI CSCL 06K

A solution of heat pipe freeze up problems through the use of mixtures as heat pipe working fluid is presented. Data on the freezing point of mixtures of 1-propanol and water were experimentally obtained. Experimental gas emission tests of potential space suit heat pipe materials when exposed to both a vacuum environment, and a water vapor environment were performed. A literature search was conducted to select film enclosure materials suitable for flexible heat pipe application with one of the desired film selection characteristics being impermeability to noncondensable gases. To reduce the thermal gradient from the heat pipe outer surfaces to the active wick surfaces, studies of the thermal conductivity of metallic wicking materials and methods of bonding wicks to substrates were performed. Techniques are described for the fabrication of an experimental heat pipe device which was used to demonstrate techniques applicable to extravehicular space suit controllable heat pipe devices for temperature control. Author

N69-10652# Entwicklungsring Sud, Munich (West Germany).
HUMAN PERFORMANCE IN AIRCRAFT GUIDANCE AND MOTION TRACKING TASKS [DAS LEISTUNGSVERHALTEN DES MENSCHEN IN FLUGFUEHRUNGS- UND BEWEGUNGSFOLGEAUFGABEN]
Ruediger Seifert 1968 14 p refs In GERMAN Presented at the WGLR Conf., Bad Godesberg, West Ger., 4–7 Oct. 1968
(EWR-116/68) Avail: CFSTI

Time lags for perception, simple reaction time, and attention shift are discussed. Due to these limits, man is only to a rather limited extent able to perform tracking tasks. Therefore a system can only be controlled by man, if its control characteristics are reduced, by technical controllers and other devices, and are adapted to the abilities of man. Controllability is also influenced by the display characteristics. For tracking tasks the head-up display seems to be most efficient. Author

N69-10709*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF PASSIVE TEMPERATURE AND HUMIDITY CONTROL SYSTEMS FOR ADVANCED SPACE SUITS Final Second Phase Report, 2 Sep. 1967–1 Sep. 1968
A. P. Shlosinger Nov. 1968 63 p refs
(Contract NAS2-3817)
(NASA-CR-73270; TRW-06462-6008-R000) Avail: CFSTI CSCL 06K

Techniques were developed for control of temperature in an extravehicular space suit by radiation of heat from the external space suit surface. Modified heat pipes, permitting control of heat flow were developed as means of heat transmission from the skin of an astronaut to the external suit surface. Flexible heat pipes were developed for heat removal by direct contact with the human skin. The techniques are intended to be eventually integrated with passive control of humidity in space suits. This report summarizes research activities in the area of controllable two-chamber heat pipes. The flexible heat pipes use water as working fluid and operate in a temperature range such that the internal pressure is significantly lower than the pressure of the external environment. Design and fabrication of a space suit wall prototype panel including rigid and flexible heat pipes and thermal switching capability are described. Author

N69-10720# Union Carbide Nuclear Corp., Oak Ridge, Tenn. Y-12 Plant.
AIR CLEANING AT THE AEC's Y-12 PLANT
J. C. Little 31 Jul. 1968 20 p Presented at Intern Atomic Energy Authority Joint Conf. on Air Cleaning No. 10, 28–30 Aug. 1968
(Contract W-7405-ENG-26)
(Y-EF-170; CONF-680812-1) Avail: CFSTI

The air-cleaning facilities used in the nuclear production operations and biological research activities at Y-12 are described, using schematic flow diagrams. The clean room facilities are also described. Problem areas are considered with emphasis on filter failures. Results of filter testing are summarized, and some problems in the mounting of high-efficiency filters are discussed. The design of a contamination control facility is discussed briefly. NSA

N69-10813*# California Univ., San Diego.
EXPERIMENTS ON VISUAL ACUITY AND THE VISIBILITY OF MARKINGS ON THE GROUND IN LONG-DURATION EARTH-ORBITAL SPACE FLIGHT
S. Q. Duntley, R. W. Austin, J. L. Harris, and J. H. Taylor Washington NASA Nov. 1968 231 p refs
(Contract NAS9-5095)
(NASA-CR-1134; SIO-Ref-68-6) Avail: CFSTI CSCL 06S

Visual acquity experiments conducted during the Gemini program are discussed. The report sets forth the evolution of the experimental design, the preparatory experiments, the equipments constructed, the training of flight crews and teams of experimenters, the selection of ground sites, their preparation and operation, the inflight experiments on Gemini 5 and Gemini 7, the resulting data and their interpretation, the conclusions and their meaning in terms of the Apollo mission and other future spaceflights, as well as certain suggestions for future inflight tests of human visual capabilities in space. Author

N69-10907 Polish Academy of Sciences, Lodz.
HUMAN REACTIONS TO STRESS CONDITIONS SIMILAR TO THOSE ENCOUNTERED DURING LONG-DURATION SPACEFLIGHT [ZACHOWANIE SIE CZLOWIEKA W BYTUACJI STRESSOWEJ PODOBNEJ DO WARUNKOW DLUGOTRWALEGO LOTU KOSMICZNEGO /WYPRAWA SPELEOLOGICZNA/]
Krystyna Galubinska *In its* Progr. in Astronautics 1967 p 89–102 refs In POLISH (See N69-10903 01-30)
Avail: CFSTI

Experiments are described in which the behavior of two groups was observed under stress while isolated for 14 days in mountain caves. The groups included males as well as females. The individuals were required to perform a number of tasks. Perceptual functioning, psychomotor performance, and psychometric tests are evaluated in this paper. The reactions of the individuals are assessed in terms of motivation, emotional stability, educational level, and similar personal traits. Transl. by K.W.

N69-10987# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
OPTIMUM QUADRUPED CREEPING GAITS Scientific Interim Report
R. B. McGee and A. A. Frank Jul. 1968 38 p refs
(Grant AF-AFOSR-67-1018A)
(AD-675256; USCEE-294; AFOSR-68-1845) Avail: CFSTI CSCL 6/3

This paper examines all of the theoretically possible quadruped gaits. Only six gaits can be executed while three feet are on the ground at all times. These six, called creeping gaits, permit a quadruped to remain statically stable during most of a locomotion cycle. The gaits were analyzed by means of a 2n-1 parameter model with extensions that account for basic kinematic parameters associated with geometric aspects of a quadruped machine or animal. The model considers only steady state, constant speed locomotion in a straight line over a horizontal plane supporting

surface with the legs of the system cycling periodically in both space and time. Only three of the six gaits enable the quadruped to be statically stable at all times. Of the three, one is a unique optimum gait with maximum static stability. The gait corresponds to the normal quadruped crawl favored by most animals for very low speed locomotion. The model, though idealized, appears sufficiently close to reality to permit qualitative extrapolation to real locomotion systems. Stability analysis of biped gaits requires the use of dynamic models that will necessarily be more complex than the kinematic model. Author (TAB)

N69-11042*# Space Sciences, Inc., Chicago, Ill. Biosystems Div.
VISION DURING MANNED BOOSTER OPERATION Final Report
Arne Troelstra, William O'Neill, and Lawrence Stark Waltham, Mass. Apr. 1968 160 p refs
(Contract NAS8-20381)
(NASA-CR-98078) Avail: CFSTI CSCL 06S

The literature concerning the human eye lens is reviewed, and the relevant characteristics of the various elements of the accomodation feedback control system are indicted. Information on the anatomy, physiology, and functional experimental procedures relative to the accommodative process is presented emphasizing quantitative aspects. Methods of measuring accommodation are also stressed. Image formation is studied from the classical and the spatial transformation viewpoints. A survey of dynamic optometers points out the requirements for experimental instrumentation. Possible clinical and mission oriented applications of a proposed optical status tester are outlined for monitoring the ocular near-reflex under various environmental conditions. K.W.

N69-11291*# Franklin Inst., Philadelphia, Pa. Biodynamics Lab.
[RESEARCH IN LIFE SCIENCES INSTRUMENTATION PERTINENT TO STUDIES IN SPACE BIOLOGY] Quarterly Progress Report, 1 Jul.–30 Sep. 1968
R. M. Goodman Sep. 1968 8 p
(Contract NSR-39-005-018)
(NASA-CR-97745; Q-B2299-14) Avail: CFSTI CSCL 06B

Subcarrier oscillators (SCO) with center frequencies of 1.7 Kc/S, 3.0 Kc/S and 5.4 Kc/S have been developed for temperature sensing. Preparation of electrodes for use in telemeters is continuing. Epoxies, waxes, shellacs, pure and modified with fillers have been tested for sealing metal electrodes to glass. Epoxies have been determined to be the best for this purpose and are being used in the fabrication of electrodes. Silver-silver chloride electrodes made of commercially pure silver wire have been sealed into glass and chloridad. Tests indicate that most pairs show less than two or three millivolts inter-electrode potential when freshly made and after shorting and ageing in a conductive solution show only a fraction of a millivolt between pairs. Some of these electrodes, coated with a transparent silastic, are permeable to water and show no difference from uncoated ones with respect to potential and stabilize quite rapidly. A method of obtaining a long lasting intervening film of KCl between the AgCl and silastic is being developed and, if successful, will be used as the reference electrode against other types, especially the pH electrode. A.L.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellents.

N69-10018# Oak Ridge National Lab., Tenn. Gaseous Diffusion Plant.
CONCENTRATION AND COLLECTION OF KRYPTON AND XENON BY SELECTIVE ABSORPTION IN FLUOROCARBON SOLVENTS
J. R. Merriman, J. H. Pashley, K. E. Habiger, M. J. Stephenson, and L. W. Anderson [1967] 14 p refs Presented at Symp. on Operating and Develop. Experience in the Treat. of Airborne Radioactive Wastes, New York
(Contract W-7405-ENG-26)
(K-L-6198; CONF-680811-3) Avail: CFSTI

Developments in studies on preferential absorption of noble gases in a high capacity fluorocarbon solvent are discussed. The primary emphasis is on determining scale-up data necessary to design plant systems for a variety of applications, including: the treatment of air within a nuclear reactor containment building in the event of an accidental fission gas release; off-gases from processing plants reclaiming values from irradiated fuel; and gases that blanket the cores of certain types of nuclear reactors. The results of tests on two refrigerants, trichlorofluoromethane and dichlorodifluoromethane, are discussed. NSA

N69-10044 Illinois Univ., Chicago.
HIGH PRESSURE MOSSBAUER STUDIES OF IRON COMPOUNDS
Robert Walton Vaughan (Ph.D. Thesis) 1967 172 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-1878

Mossbauer resonance has been used to study the effect of very high pressure on the electronic structure of iron in its various chemical states. The necessary apparatus to make Mossbauer measurements with the absorber under pressures exceeding 200 kilobars was constructed and then used for a systematic investigation of the effects of pressure on ferric, ferrous, and covalent iron compounds. The principle data taken were changes in the electron density at the iron nucleus and in the electric field gradient present at the iron site in the following materials: FeS_2 (pyrite), $Fe(C_5H_5)$ (ferrocene), FeO, αFe_2O_3, $FeTiO_3$, $KFeF_3$, K_2FeF_6, $Fe_2(Cr_2O_7)_3$, and two iron phosphates. Pressure induced changes in the isomer shift, or electron density at the iron nucleus, were found to be significant, total shifts in 200 kilobars being 10% to 20% of the difference between values associated with ferric and ferrous states. The pressure induced changes were correlated with the chemical state of the iron. Dissert. Abstr.

N69-10046 Illinois Univ., Chicago.
NEAR INFRARED ABSORPTION BANDS OF THE HYDROXYL IONS IN ALKALI HALIDE CRYSTALS
Brent Merle Wedding (Ph.D. Thesis) 1967 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-1880

The near infrared absorption bands due to OH^- in NaCl, NaBr, KCl, KBr, KI, and RbCl have been measured at temperatures ranging from 1.4°K to 380°K. Energy levels of the hydroxyl dipole in the crystal lattice were determined from the spectra. The crystals were grown by the Czochralski method in a purified argon atmosphere. The spectra were measured with a spectrophotometer assembled from commercially available components. Three cryostats were used: (1) an immersion cryostat which operated at 1.4°K with the sample in pumped liquid helium; (2) a conduction cryostat with exchange gas switch coupling to the liquid helium bath for sample temperatures between 4.5°K and 78°K; and (3) an exchange gas switch equipped liquid nitrogen cryostat for temperatures between 78°K and 380°K. The helium temperature spectra consist of three classes of absorption bands: (1) the O-H stretching absorption (main band) near 3600 cm^{-1}; (2) a side band at about 300 cm^{-1} higher energy due to torsional oscillation (libration); and (3) low-lying side bands at splittings ranging from about 5 cm^{-1} in KI:OH to 40 cm^{-1} in KBr:OH. Spectra of

KCl:OD and KBr:OD were measured to confirm the librational assignment of the 300 cm^{-1} band, and the rotational barrier was calculated using the Devonshire theory. Dissert. Abstr.

N69-10049 Brown Univ., Providence, R. I.
THE OXIDATION OF NITRITE ION BY AQUEOUS PEROXYDISULFATE ION. AN ISOTOPIC-LABELLING STUDY OF THE DECOMPOSITION OF MONOPEROXYPHTHALIC ACID IN AQUEOUS SOLUTION
Richard Edwin Ball (Ph.D. Thesis) 1967 127 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-1435

The results of a study of the kinetics of the oxidation of nitrite ion by peroxydisulfate ion in aqueous solution are reported. The kinetic behavior of the reaction is described by the two term rate law. The value of the second order rate constant k_2 is 1.5 $\times$ 10^{-2} liter $mole^{-1}min^{-1}$ at 60°, while the value of k_1 is 1.9 $\times$ 10^{-4} min^{-1}. The value of k_1 is related to the first order rate constant for the thermal decomposition of $S_2O_8^{=}$ in aqueous solution. The involvement of an intermediate in the reaction is suggested by the effect of allyl alcohol on the rate of disappearance of nitrite ion. However, no evidence for the existence of NO_2, as a reaction intermediate could be obtained. A double isotopic labelling technique was applied to study the mechanism of decomposition of monoperoxyphthalic acid in aqueous solution. The peroxy acid was decomposed, and the evolved oxygen gas was collected and analyzed with a mass spectrometer. It was determined that over 70% of the evolved oxygen is scrambled ($O_2^{16,18}$). Dissert. Abstr.

N69-10065 Stanford Univ., Calif.
DYNAMICS OF SELECTIVE MOLECULAR EXCITATION: LASER PHOTOCATALYSIS OF BROMINE REACTIONS
William Benjamin Tiffany (Ph.D. Thesis) 1967 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-17514

A frequency-tuned, high repetition rate ruby laser was designed and used as a light source for the selective photocatalysis of gas-phase reactions between bromine and certain unsaturated fluorocarbons. The purpose was to demonstrate for the first time the usefulness of highly monochromatic, tunable laser light for selective molecular excitation. In this study, certain lines were identified as belonging to particular isotopic species of bromine molecules. It was not known if weak continuous absorption, indicative of direct dissociation, also occurs in the same spectral region. Absorption of the laser light by the bromine caused it to react with the fluorocarbon. Either perfluorobutene or heptafluorochlorobutene was used, and they gave essentially the same results. This was the first reported photochemical reaction of bromine in the 14,400 cm^{-1} region. Dissert. Abstr.

N69-10083 Kansas Univ., Lawrence.
THE CHEMICAL AND THERMODYNAMIC PROPERTIES OF VANADIUM BORIDES AND RELATED SYSTEMS
Karl Eugene Spear, II (Ph.D. Thesis) 1967 457 p
Avail: Univ. Microfilms: HC $20.70/Microfilm $5.85 Order No. 68-637

This dissertation is on the high temperature chemistry of vanadium, especially the vanadium borides, and is in three parts. The first part relates to the vanadium-boron system and reports studies of phase relationships, structures, vaporization behavior, and thermodynamic properties. The second part relates to the vanadium-boron-nitrogen system and presents equilibrium and thermodynamic information. The third part relates to chemical transport studies involving both elemental and combined vanadium and reports phase and thermodynamic information obtained from these studies. Dissert. Abstr.

N69-10084 Cincinnati Univ., Ohio.
BUBBLE AND FOAM FRACTIONATION
Dean Owen Harper (Ph.D. Thesis) 1967 115 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-2003

Bubble fractionation is the partial separation of a surface active solute from its solvent which results from adsorption of the surfactant at the bubble interface. As the bubbles rise the adsorbed solute is carried up the column. At the top of the column the bubbles break thereby depositing a layer of solution rich in the solute. Axial eddy diffusion of the solute and gross circulation of the solution down the column oppose the separation. In a batch operation at steady state the rates of solute transport up and down the column are equal and a concentration gradient is established. The solution at the top of the column is rich in solute and that at the bottom is lean. Assuming the solution and interface concentrations to be in equilibrium the linear isotherm is used to predict the concentration profile and terminal (top and bottom) concentrations. In addition the Langmuir isotherm is used to solve the differential equations but the result is too unwieldy to be used in interpreting the data. Dissert. Abstr.

N69-10103 Wisconsin Univ., Madison.
THE HYDROGEN REDUCTION OF SILVER, COPPER, NICKEL, COBALT, AND IRON SULFIDES AND THE FORMATION OF FILAMENTARY METAL
Robert Edward Cech (Ph.D. Thesis) 1967 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 67-12111

The thermodynamics for the reduction of copper, nickel, cobalt, and iron sulfides were considered, and it was shown that chemical equilibrium in the system could be markedly changed by mixing a hydrogen sulfide scavenging agent with the metal sulfide particles. Hydrogen reduction experiments were carried out on the sulfides of silver, copper, nickel, cobalt, and iron, mixed with a scavenging agent for hydrogen sulfide, in order to determine the conditions that lead to the precipitation of metal in a filamentary form. Nickel, cobalt, and nickel-cobalt alloy sulfides could be reduced to filamentary metal in the same manner as that which was already known for copper and silver sulfides. In addition, nickel, cobalt, and nickel-cobalt alloy sulfides could, under some conditions, be reduced to yield single crystal filaments, a type not known to form upon reduction of either copper or silver sulfides. The metallography and kinetics of nickel sulfide reduction were studied to elucidate the mechanism of single crystal filament formation and the rate-limiting step. It was found that a necessary condition for the growth of single crystal filaments was the presence of metastable eutectic liquid at the metal-sulfide interface. The rate-limiting step of reduction in a scavenged system was the reduction reaction at the gas-solid interface. Dissert. Abstr.

N69-10126*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OBSERVATIONS ON PERMEATION OF POLYTETRAFLUOROETHYLENE BY COMPOUNDS OF RHENIUM, MOLYBDENUM, AND TUNGSTEN
Harold Leibecki Washington Nov. 1968 16 p refs
(NASA-TN-D-4886) Avail: CFSTI CSCL 07B

Observations of diffusion of rhenium, molybdenum, and tungsten hexafluorides into polytetrafluoroethylene and hydrolysis of the resultant material are reported. Exposure of polytetrafluoroethylene to rhenium or molybdenum hexafluoride, followed by hydrolysis, results in impregnation of the plastic with a metal compound. Tungsten hexafluoride was observed to grow a fibrous product (composition unresolved) on the surface of the plastic during ambient air hydrolysis. Rhenium hexafluoride hydrolysis yielded a mixture of rhenium oxides. The polytetrafluoroethylene sample was investigated for electrical conduction and was found to be substantially more conductive than the pure plastic. The hydrolysis product of molybdenum hexafluoride

impregnation was postulated to be a mixture of molybdenum oxides. The electrical conduction properties of the product were not investigated. Author

N69-10127 Louisiana State Univ., Baton Rouge.
MOLECULAR LUMINESCENCE STUDIES
Brihmadesam Narasimhan Srinivasan (Ph.D. Thesis) 1967 191 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 67-17346

The rise lifetimes and decay lifetimes of the long-lived luminescences of napthalene-d_8, phenanthrene and triphenylene in solution in rigid glasses, and of phenanthrene-d_{10}, phenanthrene, naphthalene-d_8 and chrysene in solution in a biphenyl mixed crystal system have been investigated. It has been found that the rise-time is invariably shorter than the decay time. The processes of excimer and delayed excimer fluorescence of pyrene in propylene glycol have been investigated in the temperature range 300° to 170°K. It is shown that all results are explicable on the basis of a kinetic mechanism which invokes only contact triplet-triplet annihilation. Phosphorescence, fluorescence, delayed fluorescence, excimer fluorescence and delayed excimer fluorescence of pyrene have been studied in a host biphenyl system. Semiempirical charge self-consistent MO calculations have been carried out for a very large number of benzene dimers of different geometric conformations. It has been found that the most stable excimer conformation is one in which the rings are rotated relatively about the D_{6h} axis and/or tilted, one with respect to the other. Dissert. Abstr.

N69-10130 Alabama Univ., University.
POLAROGRAPHY OF THALLIUM 204
Robert Allen Culp, Jr. (Ph.D. Thesis) 1967 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-1031

The polarography of thallium was monitored by use of the radioactive isotope T1-204. The parameters temperature, column height, concentration, etc., which are usually encountered in polarography, were applied to the radiochemical data. It was possible to determine concentrations of the radioactive solutions in the range of 10^{-11} to 10^{-10} M. The activity deposited was dependent on the concentration of the stable isotopes of thallium. The use of the technique gave direct information as to effect of the maximum suppressor, Triton X-100, on the reduction of thallium. In the presence of oxygen the activity deposited was higher than when the solution was degassed. This indicated that the HO^-_2 species that was formed upon the reduction of oxygen, thought to be specifically adsorbed to the mercury, further reduced the thallium after the drop was detached from the capillary. The reduction of thallium was followed in the presence of iodate, hydrogen peroxide, lead, and manganese, all of which again masked the thallium curve, at potentials where these species were reduced. Dissert. Abstr.

N69-10154 California Univ., Berkeley.
DISSOCIATION OF HYDROGEN ON TANTALUM USING MODULATED MOLECULAR BEAM TECHNIQUE
Robert Anthony Krakowski (Ph.D. Thesis) 1967 273 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.55 Order No. 68-96

The dissociation of molecular hydrogen on hot tantalum surfaces was studied with a high vacuum apparatus using a modulated molecular beam-mass spectrometric technique. The beams were modulated and the products measured by a phase-sensitive detector to improve the signal-to-noise characteristics of the detection system. The degree of dissociation was studied as a function of the surface temperature, beam temperature, and beam intensity. Experimental results were analysed in terms of phenomenological first and second order kinetic models. Within the pressure (3×10^{-7} torr) and temperature (1000 to 2500 K) ranges studied, all data agreed best with the first order mechanism, and yielded 65 kcal/mole for the hydrogen/metal bond energy. At a given temperature, dissociation increased with the beam temperature with an apparent activation energy of 1.4 kcal/mole, which was independent of the surface temperature. The rate of dissociation varied linearly with the beam intensity. Mixed hydrogen/deuterium beams were employed to investigate the isotope exchange reaction, and, within the sensitivity of the detection system, exchange did not take place. A simple kinetic model, which proposes a high adatom recombination probability before significant surface diffusion occurs, was proposed to explain the observed first order kinetics. Also, hydrogen solubility in the metal bulk was considered as a possible source for the observed nonequilibrium behavior. Dissert. Abstr.

N69-10166 Cincinnati Univ., Ohio.
LOW TEMPERATURE SPECIFIC HEATS OF SOME RARE EARTH DOUBLE NITRATES
William H. Rauckhorst (Ph.D. Thesis) 1967 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-2015

The specific heats of several rare earth double nitrates have been measured in the range 1.8°K to 20°K. These compounds have the chemical formula $X_2Mg_3(NO_3)_{12}\cdot 24\ H_2O$, where X is La, Ce, Nd, Pr, or Sm. The measurements were made in a cryostat which featured a mechanical heat switch for cooling the sample. A germanium resistance thermometer was used to measure the temperature. This thermometer was calibrated below 4°K against the vapor pressure of liquid helium and above 4°K against a helium gas thermometer. The samples were single crystals of approximately 15 grams which had been grown by slow evaporation of a saturated solution in a dessicator. Preparation of the solutions was from the nitrates. Dissert. Abstr.

N69-10168 St. Louis Univ., Mo.
FIVE-COORDINATE NICKEL COMPLEXES
John Francis Sieckhaus (Ph.D. Thesis) 1967 147 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-1238

In this work the factors affecting the formation of square pyramidal complexes of general formula $Ni(Chelate)_2X+$ (where X is a halide) were investigated, and several bidentate ligands containing phosphorus and sulfur were synthesized. These include diethylphosphinoethyl ethyl sulfide (DPES), 1, 3-bis (diethylphosphino) propane (TETMP), tetraethyldiphosphine (TEP), and 1, 2-bis (diphenylphosphino) ethane (DFE). The ligands were prepared in general by the alkylation of phosphine in liquid ammonia, and the metal adducts were obtained through simple addition reactions with the appropriate nickel salt. The stoichiometries and structures of the nickel complexes were determined through elemental analyses, magnetic susceptibilities, molar conductances, and infrared and visible spectra. In conclusion, some observations were made concerning Pearson's Hard-Soft Acid-Base Theory as applied to nickel halide and thiocyanate complexes. Dissert. Abstr.

N69-10171 Mississippi Univ., University.
GAMMA-RAY RADIOLYSIS OF PENTABORANE-9 IN THE GAS PHASE
James Wesley Pinson (Ph.D. Thesis) 1967 187 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-2141

Pentaborane-9 was irradiated in the gas phase with Co^{60} gamma radiation. Product analysis was carried out using standard high vacuum and gas chromatographic techniques. The gaseous products obtained were hydrogen, diborane, and tetraborane-10 as well as nonvolatile and volatile solid fraction. The volatile solid fraction was identified as decarborane-16 by physical properties, infrared, and mass spectrometry. The nonvolatile solid fraction was analyzed by infrared and mass spectrometry. The results indicated

the solid was hydrolytic in moist air and contained a variety of B–H and B–B bonds. For the combined solid a mass range of 109–123 mass units was obtained. The central mass unit, 116, was used in subsequent calculations. Dissert. Abstr.

N69-10172 Wisconsin Univ., Madison.
CYCLOPENTADIENYL PERFLUOROALKYL COMPLEXES OF COBALT AND DICYCLOPENTADIENYL COMPOUNDS OF NIOBIUM
Gerhardt Paul Werber (Ph.D. Thesis) 1967 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 67-12490

Several new cyclopentadienyl perfluoroalkyl complexes of cobalt were prepared utilizing $\pi-C_5H_5Co(CO)R_FI$ ($R_F = C_2F_5$ and C_3F_7) and various preparative techniques. These compounds were cationic, neutral, and anionic in nature. The ^{19}F n.m.r. spectra of these complexes were obtained and discussed in relation to the structures proposed for these compounds. Models have been developed to predict structures for these compounds based on steric considerations of the ligands and the cyclopentadienyl ring protons. The proposed structures were used to explain mechanisms of compound formation and reactivity for these and other metal substituted dicyclopentadienyl compounds. The infrared spectra of dicyclopentadienyl transition metal compounds were analyzed and discussed in view of these proposed structures. Dissert. Abstr.

N69-10173 Kansas Univ., Kansas City.
PART 1: LIGHT-CATALYZED REACTIONS OF IODOBENZENE DICHLORIDE WITH HYDROCARBONS. PART 2: REACTIONS OF POTASSIUM HEXACYANO-CHROMATE (III) AND SOME TRANSITION METAL CYANONITROSYLS WITH MOLECULAR HYDROGEN AT ELEVATED TEMPERATURES
David Franklin Banks (Ph.D. Thesis) 1967 168 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-563

In the light-catalyzed reaction of iodobenzene dichloride with 2, 3 dimethylbutane, only 2 chloro 2, 3 dimethylbutane and its dehydrohalogenation product are formed in addition to iodobenzene and hydrogen chloride. By comparison, in the reaction of chlorine with this substrate approximately 60 parts of the 1 chloro and 40 parts of the 2 chloro isomer are formed. This evidence indicates that the hydrogen-abstracting radical is definitely not atomic chlorine, but is most probably $C_6H_5ICl\cdot$. Similar experiments using iodine trichloride indicate that in a light-catalyzed reaction, the hydrogen-abstracting radical is $ICl_2\cdot$. The reactions of potassium hexacyanochromate(III) and six transition metal cyanonitrosyls with molecular hydrogen at elevated temperatures were examined. Dissert. Abstr.

N69-10180 Virginia Polytechnic Inst., Blacksburg.
ORGANOMETALLIC ANIONS
Rudolph LeRoy Pohl (Ph.D. Thesis) 1967 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-2067

Polarography, cyclic voltammetry and controlled-potential electrolysis, as well as electron spin resonance spectroscopy were employed in a study of the preparation and reactivity of a number of organometallic anions. The relative nucleophilicities of 20 organometallic anions were determined by measuring the rate of reaction between these anions and simple alkyl halides. The electron transfer capabilities of these anions were also examined by observing the rate of reaction between the anions and a group of neutral organic and organometallic compounds. The electron transfer reaction between some organometallic radical anions with neutral organometallic compounds was also examined with respect to both rate and position of equilibrium. The electrochemical behavior of a group of iron carbonyl compounds containing cyclic organic ligands was examined. No anomalies were uncovered between the experimental and theoretical equilibrium constants for electron transfer reactions in a limited number of organometallic systems. Dissert. Abstr.

N69-10289 Illinois Univ., Urbana.
THE ELECTROANALYTICAL UTILITY OF BORON CARBIDE ELECTRODES
Herman David Axelrod (Ph.D. Thesis) 1967 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-1706

The utility of boron carbide as an electrode for potentiometry, anodic stripping voltammetry, and cyclic voltammetry has been evaluated. Contrary to previous reports the material was found not to be inert but rather readily attackable chemically and electrochemically. Electrochemical results have been interpreted on the basis of surface-oxygen reactions. The voltammetry of several common redox systems, has been examined. In each case the electrode processes were more irreversible than observed at other electrodes such as platinum and mercury. Use of the electrode was restricted to low scan rates because of an apparent high electrode capacitance and irreversibility of the systems studied. The electrode was found to be poorly suited for anodic stripping analysis. Stripping peak currents were low with a run-to-run producibility of 10 percent. Dissert. Abstr.

N69-10291# National Research Council of Canada, Ottawa (Ontario).
INVESTIGATION OF LINE INTENSITIES OF RAMAN SPECTRA OF GASES AT LOW PRESSURES BY A PHOTOELECTRIC METHOD
Yu. A. Lazarev and P. A. Bazhulin 1968 7 p refs Transl. into ENGLISH from Fiz. Probl. Spektroskopii, Akad. Nauk SSSR, Materialy 13-Go Soveshchaniya (Leningrad), v. 2, 1963 p 22–25 (NRC-TT-1340) Avail: Issuing Activity

Summary data are presented on the photoelectric measurements of integral line intensities of H_2, O_2, N_2, CO, CO_2, CH_4, C_2H_2, and C_2H_4. Intensities were determined from the contours of the Q branches with a spectral slit width of 5 to 7 cm^{-1} in a pressure range of 1 to 10 atm with an accuracy of not less than 10%; excitation lines were 4358 and 4047 A. The methane line, with frequency ν_1, was used as a line of comparison. Observations were made of the relationship between the intensity and the pressure in the rotational lines of H_2, O_2, and N_2 in the rotational–oscillational lines of H_2, O_2, and N_2, the ν_1 and $2\nu_2$ lines of CO_2, the ν_1 line of CH_4, and the ν_5 line of C_2H_2. In no case was a departure from the linear relationship noted. Also included is a comparison of the experimental results with theoretical data. M.G.J.

N69-10292*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
IMPROVED SAMPLING AND ANALYTICAL PROCEDURE FOR NITROGEN TETROXIDE AND MIXED OXIDES OF NITROGEN
Stephen P. Vango 15 Oct. 1968 13 p ref
(Contract NAS7-100)
(NASA-CR-97491; JPL-TR-32-1282) Avail: CFSTI CSCL 07D

A scheme for sampling and analyzing nitrogen tetroxide and the mixed oxides of nitrogen is presented. The procedures described overcome some serious deficiencies of the usual military procedures. The improved sampling procedure provides meaningful samples for these hydroscopic and volatile materials, and the analytical procedure eliminates an inherent error in the military procedures when carbon dioxide is present as a dissolved impurity. Some other modifications in the military procedure are also described. Author

N69-10315# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.

OXIDATION OF CERIUM(III) BY OZONE AND BY ELECTROLYSIS

R. E. Lerch. Aug. 1968 24 p refs
(Contract AT(45-1)-1830)
(BNWL-805) Avail: CFSTI

Cerium(III) can be electrolytically oxidized to cerium(IV) on a batch type basis in glass, titanium, or zircaloy vessels, but not in a stainless steel vessel. The process would probably consist of concentrating the cerium to between 0.1*M* and 0.15*M* in *eM* to 8*M* nitric acid followed by oxidation and then extraction using 0.3*M* HDEHP (bis(2-ethylhexyl) ester of phosphoric acid)-0.2*M* TBP (tributyl phosphate) in NPH diluent. The use of ozone is not feasible for oxidation of cerium(III) to cerium(IV) since the rate of reaction is very slow (even with a catalyst) and because a holding oxidant is necessary during the extraction step. Author (NSA)

N69-10322# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).

NUCLEAR MAGNETIC RESONANCE STUDY OF FERROELECTRIC TRANSITIONS IN SODIUM TRIHYDROGEN SELENITE AND DEUTERATED SODIUM TRIHYDROGEN SELENITE

R. Blinc, J. Stepisnik, and I. Zupancic. Apr. 1968 14 p refs Sumbitted for publication
(NIJS-R-531) Avail: Issuing Activity

The angular dependences of the proton, deuteron and Na^{23} magnetic resonance spectra have been measured as a function of temperature in both normal (STSe) and deuterated (D-STSe) sodium trihydrogen selenite and the electric field gradient tensors at the sodium and deuteron sites have been determined. These data show that the two ferroelectric transitions in STSe (from 2/m → 1 → m) are accompanied by a doubling of the unit cell edges in the a and b, respectively b-direction with respect to the paraelectric unit cell whereas there is just one transition in D-STSe (from 2/m → m), which is connected with a doubling in the b direction only. The triclinic ferroelectric phase which exists in STSe between −79° and −173°C thus does not appear in D-STSe. The transitions are accompanied by an ordering of hydrogens (which are in the paraelectric phase rapidly jumping from one equilibrium site in the H-bond to another) as well as by a distortion of the SeO_3^- and Na^+ network. Author

N69-10323# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).

ON THE HIGH TEMPERATURE PHASE TRANSITION IN POTASSIUM DIHYDROGEN PHOSPHATE

R. Blinc, V. Dimic, D. Kolar, G. Lahajnar, J. Stepisnik et al. Jun. 1968 14 p refs Submitted for publication
(NIJS-R-536) Avail: Issuing Activity

The high temperature phase transition in KH_2PO_4 has been investigated by differential thermal analysis, thermogravimetric analysis, proton magnetic resonance and relaxation, infrared spectroscopy and X-ray and quasielastic cold neutron scattering. The transition is not connected with a static breaking up of the hydrogen bond network but rather with the onset of disordered hindered rotation of the H_2PO_4 groups around all three axes. It seems that rotation of H_2PO_4 groups is as well rate determining for the proton conductivity of this crystal. Author

N69-10327 Brown Univ., Providence, R. I.

THE MAGNETIC STUDY OF TRIGONAL GROUND STATE SPLITTING IN TRANSITION METAL COMPLEXES

Emanuel George Terezakis (Ph.D. Thesis) 1967 70 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-1507

The preparation and magnetic properties of the following compounds are described: titanium(III) chloride hexahydrate, vanadium(III) chloride hexahydrate, hexaureavanadium(III) bromide, guanidine hexaquovanadium(III) sulfate, guanidine hexaquochromium(III) sulfate and tris(2,2'-dipyridyl)chromium(II) bromide tetrahydrate. Magnetic evidence is presented for the existence of ground state splittings arising because of trigonal distortion of the ions from octahedral symmetry. The results are in agreement with theories that relate the magnetism of these compounds with spin-orbit coupling and a trigonal or tetragonal distortion. The results are qualitatively consistent with spectral data obtained in this laboratory on the same, or analogous, compounds. The construction of a Gouy balance temperature controller operating in the range 77–380°K is described. Dissert. Abstr.

N69-10358# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

A STUDY ON THE RADIATION INDUCED FREE ION YIELDS IN n-ALKANES

Kiyoshi Takada et al. *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 85–95 refs (See N69-10348 01-18) Avail: CFSTI

Radioinduced free ion yields in n-alkanes, from pentane to decane were obtained from the electrical conductivity measurement and Gzowski's mobility. In alkanes lower than octane, G-values for free ion yield decreased gradually with increasing carbon number and became almost constant, 0.03 to 0.04, in octane, nonane, and decane. It was theorized that the main reason for such differences lies on the range distribution of secondary, tertiary, etc., electrons, i.e., energy distribution of emitted electrons and energy-range relation in each medium. Author (NSA)

N69-10359# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

THE ESTIMATION OF FREE ION LIFETIME BY PULSE ELECTRICAL CONDUCTIVITY

Kanae Hayashi et al. *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 96–103 refs (See N69-10348 01-18)
Avail: CFSTI

The estimate of free ion lifetime was carried out from the combination of pulse X irradiation (repetition time, 10 to 250 msec) and electric conductivity measurements on cyclohexane. The cell current ratios decreased at slow pulses keeping the dose rate constant. A deviation from ordinary kinetics of intermittent illumination at slowest pulse was observed and a probable explanation for it was proposed. The estimated life time agreed with that calculated from steady state conductivity within a factor of two. Author (NSA)

N69-10362# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

ELECTRON SPIN RESONANCE STUDY OF IRRADIATED CYCLIC ETHERS

Kozo Tsuji et al. *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 117–132 refs (See N69-10348 01-18)
Avail: CFSTI

Free radicals formed by irradiating cyclic ethers at 77°K were studied by the electron spin resonance method. From cyclic ethers containing one oxygen atom, free radicals were formed mainly by the abstraction of a hydrogen atom from the carbon atom adjacent to oxygen. In the same way, free radicals were formed from cyclic ethers containing two oxygen atoms separated from each other by two carbon atoms. From cyclic ethers containing a sequence of oxygen-carbon-oxygen in the ring, free radicals were formed mainly by the ring opening. Author (NSA)

N69-10364# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

RADIATION INDUCED POLYMERIZATION OF ISOBUTENE AT LOW TEMPERATURE GLASSY STATE

Hideo Kamiyama et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 145–157 refs (See N69-10348 01-18)

Avail: CFSTI

The reaction mechanism of radioinduced polymerization of isobutene was studied by measurement of its near infrared spectra in 3-methylpentane glass at liquid nitrogen temperature. Direct evidence was given for the fact that almost the entire reaction propagates as in-source polymerization at 77°K. From the measurement on the samples of various concentrations, it was concluded that the rate of polymerization is proportional to the 1.87 power of the monomer concentration. A determination of the number-averaged molecular weight by the quantitative treatment of the absorption intensity was made for the micro quantity of the obtained sample of polyisobutene, and using its results G-value of the initiation of polymerization was estimated to be about 1 for the wide range of monomer concentration. Author

N69-10365# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

STUDIES ON RADIATION INDUCED SOLID STATE POLYMERIZATION ON THE CHAIN PROPAGATION IN THE SOLID STATE

Masanobu Nishii et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 158–169 refs (See N69-10348 01-18)

Avail: CFSTI

Electron microscopic observations at low temperature indicated that crystalline polymer fibrils (200 to 500A in diameter and more than 1 μ in length) were formed in a unique crystallographic direction of the monomer crystal by the radioinduced solid state polymerization of trioxane. In the solid state polymerization of acrylamide, amorphous globular polymer particles (a diameter of 300 to 400A) were formed. The chain propagation of trioxane appeared to be controlled by the regularities of ordered molecules in the crystal lattice. In the case of acrylamide, however, the reaction was not controlled by the monomer crystal lattice. Author (NSA)

N69-10366# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

RADIOLYSIS OF METHYL n-BUTYL ETHER

Junichi Takezaki et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 170–175 refs (See N69-10348 01-18)

Avail: CFSTI

Primary products of the radiolysis of liquid methyl butyl ether and their G-values were as follows: H_2 1.3; CH_4 1.5; CO 0.6; C_2H_4 0.017; C_2H_6 0.016; C_4H_8 0.013. Minor products were C_3H_8, C_4H_{10}, $CH_3OC_2H_5$, $CH_3OC_2H_7$, C_8 group, C_4H_9OH and i-C_4H_9OH (all with G values 0.003). The effects of DPPH additions were investigated. Author (NSA)

N69-10367# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

QUANTITATIVE EXPLANATION OF THE SKELETAL BOND-SCISSION OF CYCLIC ETHERS BY ELECTRON IMPACT

Junichi Takezaki et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 176–183 refs (See N69-10348 01-18)

Avail: CFSTI

Bond scission probabilities of cyclic ethers under electron impact are explained quantitatively by the LCBO-MO theory. It can be calculated by the assumptions that cycle opening occurs at each bond in proportion to the charge density of cyclic ether and the parent ions subsequently produced are of ether and aldehyde type, and these ions decompose into smaller fragment ions decomposing in proportion to the charge density of each parent ion, and that C – O bond in aldehyde type ions does not rupture, irrespective of its charge density. The theoretical values show a good correlation to the scission probability of the corresponding bond obtained from the mass spectra. Author (NSA)

N69-10369# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED BORON COMPOUNDS: SINGLE CRYSTAL OF BORAX

Siro Nagai et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 192–201 refs (See N69-10348 01-18)

Avail: CFSTI

A single crystal of borax, $Na_2B_4O_7 \cdot 10H_2O$, was irradiated with electron beams at –196°C. The free radicals produced in the crystal were studied by anisotropy in the ESR spectra. The EST spectra consisted of two sets of quartet, where each of these quartet structures arises from hyperfine interaction of an unpaired electron with ^{11}B nucleus. The free radicals corresponding to these quartets were assigned to the two different oxy radicals: $B(sp^2)-O$ and $B(sp^3)-O$. The principal values of g factor of the former radical are 2.034, 2.011, and 2.003. On the other hand, those of the latter radical are 2.089, 2.066, and 1.967. This radical has a very short spin-lattice relaxation time. Author (NSA)

N69-10376*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A METHOD FOR THE ANALYSIS OF HALOCARBON OIL CONTAMINATION IN COMPRESSED GASES

Francis J. Carlin, Jr. 7 Oct. 1968 19 p refs

(NASA-TM-X-53789) Avail: CFSTI CSCL 07D

A chromatographic method, utilizing an electron capture detector, has been developed for the detection of halocarbon oil contaminants in compressed gases. The lower limit of detection is 9×10^{-11} gm or 0.03 ppm. The upper limit of the detector is 3×10^{-9} gm or 0.9 ppm. Author

N69-10400 Howard Univ., Washington, D. C.

AN ELECTRON IMPACT STUDY OF THE PRIMARY, SECONDARY, AND TERTIARY METHYLAMINES

George Edward Alcorn, Jr. (Ph.D. Thesis) 1967 141 p

Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-13556

An inexpensive mass spectrometer, the M.S. 10, was modified for the purpose of examining the relatively untouched territory dealing with negative ions. A positive and negative ion study of the methylamines was obtained. For monomethylamine 15 positive ions and 9 negative ions were observed. Dimethylamine exhibited 31 positive ions and 7 negative ions. Capture peaks were not observed for all the negative ions mentioned. Only ion pair reactions were observed in some cases. The appearance potentials obtained for monomethylamine, dimethylamine, and trimethylamine were 9.80, 9.80, and 9.05 volts respectively. Dissert. Abstr.

N69-10408 Argonne National Lab., Ill.

CHEMISTRY DEPARTMENT, CENTER FOR NUCLEAR STUDIES AT FONTENAY-AUX-ROSES, DIRECTION OF NUCLEAR MATERIALS AND FUELS [RAPPORT SEMESTRIEL DU DEPARTMENT DE CHIMIE, CENTRE D'ETUDES NUCLEAIRES DE FONTENAY-AUX-ROSES, DIRECTION DES MATERIAUX ET COMBUSTIBLES NUCLEAIRES] Semiannual Report, Dec. 1966–May 1968

Jun. 1968 59 p refs Transl. into ENGLISH from French Rept. No. CEA-N-856, Sect. 8 and 9, Dec. 1967 p 238–297
(ANL-TRANS-626) Avail: CFSTI

Filtration and decontamination studies for processing a Mo–U alloy are described. Purification of plutonium by trilaurylamine extraction is considered. Studies were also made of the operation of pulsed columns and of the construction of a trilaurylamine regeneration unit. Treatment of U–Zr and U–Al alloys by the fluoride volatility process is described. Separation of U and Pu from mixtures of their hexafluorides is discussed. Decladding of fuel elements by magnesium melting was studied. NSA

N69-10413*# Pittsburgh Univ., Pa. Space Research Coordination Center.
SIMULTANEOUS FLOW AND TEMPERATURE CORRECTION IN THE EQUILIBRIUM STAGE PROBLEM
John W. Tierney and John L. Yanosik 7 Oct. 1968 24 p refs Supported in part by NASA
(Grant NSF G-11309)
(NASA-CR-97592; SRCC-85) Avail: CFSTI CSCL 07D

Iterative methods for the solution of the steady state equilibrium stage problem are studied. Equations are first developed for calculating the effect of a change in temperature or flow rate on all energy balances, and then it is shown that these equations can be used in the multiple variable form of the Newton–Raphson correction process to correct either the temperatures or the flow rates when only energy balance errors are used. Similar equations for material balance errors which have been developed previously are then combined with the energy balance equations to provide a method for simultaneous correction of the temperatures and the flow rates. Because first order interactions between flow rates and temperatures are included the method is applicable to a wide range of equilibrium stage problems. Sample problems are presented, and it is shown that quadratic convergence is obtained for the simultaneous correction process. Author

N69-10414*# National Bureau of Standards, Washington, D. C.
ELECTROCHEMICAL DATA. PART 10: ELECTROLYTIC CONDUCTIVITY OF AQUEOUS SOLUTIONS OF THE ALKALI METAL HYDROXIDES
Harold J. De Wane and Walter J. Hamer [1968] 27 p refs
(NASA Order R-09-022-029; NBS Proj. 2110432)
(NASA-CR-97593; NBS-9876) Avail: CFSTI CSCL 07D

This report gives a critical evaluation of the available data on the electrolytic conductivity of aqueous solutions of the alkali metal hydroxides. Results are given for sodium hydroxide at 15, 20, 25, 30, 40, 50, 60, 75, 80 and 100°C; for potassium hydroxide at 25, 30, 60, and 100°C, and for lithium hydroxide at 25°C. Author

N69-10417# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
UKRAINIAN JOURNAL OF CHEMISTRY
16 Nov. 1967 19 p refs Transl. into ENGLISH from Ukr. Khim. Zh. (Kiev), v. 32, no. 5, 1966 p 433–436, 445–448
(FTD-HT-67-406; AD-673803) Avail: CFSTI

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1. CHEMICAL PROPERTIES OF GERMANIDES OF LANTHANUM M. D. Lyutaya and A. B. Goncharuk p 1–6 refs (See N69-10418 01-06)

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N69-10418# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHEMICAL PROPERTIES OF GERMANIDES OF LANTHANUM
M. D. Lyutaya and A. B. Goncharuk *In its* Ukr. J. of Chem. 16 Nov. 1967 p 1–6 refs (See N69-10417 01-06)
Avail: CFSTI

The authors study the chemical properties of $LaGe_2$, LaGe and La_5Ge_3 at room temperature in air and in water, and the thermal stability of these compounds in air and in an ammonia atmosphere. Interaction between the germanides and water was determined from the quantity of water passing into solution with decomposition of the lanthanum germanides. Powdered materials with particles measuring 40–50 μ were used for studying the thermal stability of the lanthanum germanides. Specimens of the three compounds were interacted with ammonia at temperatures of 500–700°, and the products of the reaction were then chemically analyzed. It was found that lanthanum digermanide $LaGe_2$ is easily decomposed by moisture while LaGe and La_5Ge_3 are practically stable in water. There is a direct relationship between the composition of the lanthanum germanides and their stability in air and in an ammonia atmosphere. Lanthanum digermanide is more resistant to atmospheric oxidation at 200–400° and to interaction with ammonia at 500–700° than are LaGe and La_5Ge_3 under the same conditions. Author

N69-10419# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE EFFECT OF CHROMIUM ON THE KINETICS OF THE OXIDATION OF NIOBIUM
R. F. Voytovich *In its* Ukr. J. of Chem. 16 Nov. 1967 p 7–12 refs (See N69-10417 01-06)
Avail: CFSTI

The oxidation of niobium alloy with 10, 30, 50, 70, or 90% chromium at 500, 600, 700, 800 or 900C has been studied. The alloys were melted in a vacuum arc furnace with a tungsten electrode from 99.8%-pure niobium and electrolytic chromium. Alloy specimens were homogenized at 1000C for 20 hr. Chromium was found to decrease somewhat the strength of niobium, but to increase sharply the resistance against oxidation, particularly at temperatures up to 800C. The alloy with a chromium content over 30% showed a slight weight gain at all temperatures in 10-hr tests. Chromium promotes the formation of β-niobium pentoxide and shifts the upper limit of α-phase stability from 900C for pure niobium to 600C for Nb + 10% Cr alloy. In the presence of chromium, a new oxide phase is formed—apparently $CrNbO_4$ oxide—which slows down the diffusion of oxygen through the oxide layer. Author

N69-10437*# Stanford Univ., Calif. Dept. of Materials Science.
MECHANISM OF THE PHOTOVOLTAIC EFFECTS IN 2-4 COMPOUNDS Progress Report, 1 Apr.–30 Sep. 1968
Richard H. Bube, W. D. Gill, and P. F. Lindquist 30 Sep. 1968 36 p refs
(Grant NGR-05-020-214)
(NASA-CR-97599; SU-DMS-69-R-2; PR-3) Avail: CFSTI CSCL 07D

Phenomena involved in the observation of large current gains upon photoexcitation in the presence of a small reverse bias were examined in considerably greater detail. Depletion layer widths were investigated using the light microprobe, electron mirror microscope photographs, effects of chemical etching, and improved capacitance vs. voltage measurements. Large apparent depletion widths measured regularly with the microprobe, EMM, and etching must be associated with the effects of surface states. A barrier height of 1.1 eV was obtained from a plot of $1/C^2$ vs. V for a cell giving a straight line on such a plot, and excellent agreement was found between the $(N_D\text{-}N_A)$ obtained from this plot and bulk resistivity data. The light I-V characteristic remains below the

dark characteristic over the entire measured range, indicating that leakage paths are not important in this sample. Several other samples, whose capacitance data indicate close to ideal Schottky barrier behavior, also indicate barrier heights of about 1 eV. Spectral response data obtained with the microprobe indicate considerably more rad response on the CdS side of the junction than on the Cu_2S side. Author

N69-10439# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).

ON THE EXISTENCE OF NUCLEAR MAGNETIC RESONANCE RELAXATION BY SPIN ROTATIONAL INTERACTIONS IN THE SOLID

R. Blinc and G. Lahajnar Apr. 1968 15 p refs Submitted for publication

(NIJS-R-530) Avail: Issuing Activity

The temperature and frequency dependences of the nuclear spin-lattice relaxation times have been measured for a series of nearly spherical molecules both in the solid and in the liquid state, using a pulse technique. The same anomalous behaviour which was found before in SF_6, SeF_6 and TeF_6 is now shown to occur in MoF_6, WF_6, UF_6 and solid white phosphorus in a certain temperature range. The results seem to show that spin-rotational interactions do operate in a relatively large number of molecular solids and liquids and open the possibility of studying correlation functions for the angular velocity of molecules in the solid by NMR techniques. Author

N69-10440# Bern Univ. (Switzerland). Physical Inst.

RARE GAS MEASUREMENTS IN SEPARATE MINERAL PHASES OF THE OTIS AND ELENOVKA CHONDRITES

P. Bochsler, P. Eberhardt, J. Geiss, and N. Groegler 1968 35 p refs Presented at the Intern. Symp. on Meteorite Res., Vienna, 7–13 Aug. 1968

(SM-109/87) Avail: CFSTI

Olivine, pyroxene and feldspar mineral concentrates were prepared from the Otis and Elenovka chondrites. From Elenovka also very high purity troilite and metallic FeNi fractions were separated. The concentrations and the isotopic compositions of He, Ne and Ar were determined in these separated phases. The ^{40}K-^{40}Ar ages of the bulk meteorite, the three silicate fractions and the troilite concentrate of Elenovka are between 4.31×10^9 yr and 4.67×10^9 yr. The Otis feldspar concentrate has a ^{40}K-^{40}Ar age of 4.23×10^9 yr; the pyroxene, olivine and bulk meteorite, however, have ages between 2.24 and 2.39×10^9 yr, indicating diffusion loss in the fine grained material. Production rates of $^{38}Ar_{spall}$ from Fe and Ca, and of $^{21}Ne_{spall}$ from S, Si and Mg are calculated from the measured noble gas results and the measured chemical composition of the mineral fractions. These results are discussed and compared with published values. Author

N69-10453# Comitato Nazionale Per l'Energia Nucleare, Rome (Italy).

A STUDY ON TWO METHODS SUITABLE FOR THE INVESTIGATION OF THE INTERACTIONS BETWEEN SOME VOLATILE FISSION PRODUCTS AND THE SURFACE OF URANIUM DIOXIDE

L. G. Nagy, C. Cesarano, and G. J. Segre 1968 55 p refs

(RT/CHI(68)18) Avail: CFSTI

A heats of immersion method and a heterogeneous isotopic exchange method are considered for the investigation of the interactions between volatile fission products and the surface of uranium dioxide and related compounds. The heats of immersion method is considered useful for studying changed surface properties as well as average surface polarity; and both UO_2 and ThO_2 were investigated by this method. Heterogeneous isotopic exchange is used to investigate the chemical form of some fission products and UO_2 surface properties. Chemical forces at the solid-gas interface were also investigated; and mention is made of the surface chemical bond, the covalent bond, and the co-ionic bond as well as the surface states. M.W.R.

N69-10485# International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperatures and Refractories.

BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, VOLUME 1968, NUMBER 3

J. J. Diamond, ed (Natl. Bur. of Std., Washington, D. C.) Sep. 1968 37 p refs

Avail: Issuing Activity

Devices, properties, and reactions are covered in a bibliography on the high temperature chemistry and physics of materials in the condensed state. The references are listed alphabetically by author under a variety of categories that include properties at temperatures above 1000°C of metallic, nonmetallic and mixed materials that melt either above or below 1500°C. Thermodynamic properties at temperatures below 1000°C of materials that melt above 1500°C are also included; as are phase equilibria and reactions at temperatures above 1000°C. Devices for achieving, measuring, and controlling temperatures above 1500°C are covered by the references, which also give devices for physical measurements at lower temperatures. M.W.R.

N69-10497# Oak Ridge National Lab., Tenn.

STUDIES OF THE EMISSION OF POSITIVE SECONDARY IONS FROM SOLID TARGETS. THE USEFULNESS OF THE ION-BOMBARDMENT ION SOURCE IN MASS SPECTROSCOPY

H. E. Beske [1968] 15 p refs Transl. into ENGLISH from Z. Naturforsch. (Tuebingen), no. 22A, 1967 p 459–467

(ORNL-tr-1794) Avail: CFSTI

If solids are bombarded by ions, positive secondary ions (SI) of all elements of the target material are emitted. The mass analysis of these SI permits conclusions to be drawn about the composition of the target material. An arrangement based upon this kind of ion production is called an ion bombardment ion source. In this paper it was investigated whether or not this ion source is suitable for quantitative analysis of solids by mass spectrometry. For this purpose the SI yield of 27 elements was measured at constant bombardment conditions (12 keV Ar+ ions, 45° incidence). Aluminum shows the largest, gold the smallest SI yield. Yields differ by a factor of 1000 for different elements. The influence of the ionization energy on the SI yield is discussed. The yield is independent of the concentration in the range 0.02 to 20%. Author (N5A)

N69-10506# International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperatures and Refractories.

BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS

L. Brewer, comp. (Calif. Univ., Berkeley) 30 Sep. 1968 29 p refs

(Rept.-28) Avail: Issuing Activity

Spectroscopic studies and reactions between gases and condensed phases are covered in a bibliography on the high temperature chemistry and physics of gases and plasmas. References are to reports from 1966 through 1968. M.W.R.

N69-10519# Paris Univ. (France). Laboratoire de Recherches de Spectrochimie Moleculaire.

SYNTHESIS OF DEUTERATED ORGANIC COMPOUNDS [SYNTHESE DE COMPOSES ORGANIQUES MARQUES AU DEUTERIUM, RAPPORT FINAL] Final Report

M. L. Josien 1968 11 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-062-64-7(RISF))
(EUR-4045f) Avail: CFSTI

The preparation of 48 either partially or totally deuterated compounds is reported. These products belong to the following classes: methyl and ethyl ethers; derivatives of benzene and naphthalene; and purine and pyrimidine bases. The originality of these syntheses lies in the determination of conditions of very high specific isotopic yield. Author

N69-10527# Rocket Propulsion Establishment, Westcott (England).
SOME INTERMEDIATES IN THE PYROLYSIS AND ELECTRON IMPACT OF CHLORINE MONOXIDE AND CHLORINE HEPTOXIDE
I. P. Fisher Oct. 1967 18 p refs
(RPE-TR-67/10) Avail: CFSTI

Chlorine monoxide, Cl_2O, and chlorine heptoxide, Cl_2O_7, have been pyrolyzed and the products analysed by mass spectrometry. Cl_2O decomposed mainly to Cl_2 and O_2. Cl_2O_7 gave a large yield of ClO_2 and a smaller amount of ClO. Neither ClO_3 nor ClO_4 was observed. The ionization and dissociation of these compounds have also been studied. The ionization potentials of ClO_2 and ClO formed in the pyrolysis of Cl_2O_7 were found to be 10.7 ± 0.1 eV and 11.1 ± 0.1 eV respectively. The bond dissociation energies D(Cl-OCl) and D(ClO_3-ClO_4) have been determined to be 32.3 ± 2 kcal mole^{-1} and 30 ± 4 kcal mole^{-1} respectively. Some ionic bond dissociation energies have been calculated for the chlorine oxides and compared with those in other halogen oxides. Author

N69-10552# National Bureau of Standards, Washington, D. C. Cryogenics Div.
SATURATED LIQUID DENSITIES OF OXYGEN, NITROGEN, ARGON, AND PARAHYDROGEN
H. M. Roder, R. D. Mc Carty, and V. J. Johnson 31 Jan. 1968 80 p refs
(NBS-TN-381) Avail: SOD $0.50

Integrated tables are presented of pressure, volume, and temperature for the saturated liquid, from the triple point to the critical point, of oxygen, nitrogen, argon, and parahydrogen. The tables include entries of integral values of temperature in both Kelvin and Rankine, and integral values of pressure in both atmospheres and psia. Volumes and densities of three different units and a density ratio are tabulated for each entry. Estimates of the uncertainty of the tabulated data are given. Author

N69-10571# Los Alamos Scientific Lab., N. Mex.
THE DIELECTRIC POLARIZABILITY OF He-3
E. C. Kerr and R. H. Sherman [1967] 4 p refs Presented at Conf. on Low Temp. Phys., St. Andrews, Scot.
(Contract W-7405-ENG-36)
(LA-DC-9732; Conf.-680808-6) Avail: CFSTI

A brief description of the experimental apparatus is given. The results are described. NSA

N69-10574# Arizona State Univ., Tempe. Dept. of Chemistry.
THE SOLID STATE CHEMISTRY OF RARE EARTH OXIDE SYSTEMS Technical Progress Report, 1967–1968
Leroy Eyring, Michael S. Jenkins, Volker Scherer, Gary R. Weber, G. Duane Stone et al 10 Jul. 1968 98 p refs
(Contract AT(11-1)-1109)
(COO-1109-35) Avail: CFSTI

Research progress is reported on: detailed tensimetric studies of the praseodymium oxide oxygen system, mass transport properties of rare earth oxides, high-temperature x-ray diffraction studies, and growth of rare earth oxide crystals. NSA

N69-10578# California Univ., Livermore. Lawrence Radiation Lab.
A REVIEW OF ELECTRON IONIZATION OF ATOMS WITH EMPHASIS ON THE CROSSED BEAM METHOD
Robert H. Mc Farland 10 Jul. 1968 34 p refs Presented at Gordon Research Conf., Crystal Mt., Wash. 29 Jul.–2 Aug. 1968
(Contract W-7405-eng-48)
(UCRL-71195) Avail: CFSTI

Two experimental methods are described for the study of ionization of atoms by electron impact: (1) Tate and Smith's electron beam method for cross section measurements for permanent gases; and (2) the crossed-beam method for ionization measurements on materials which are solid at room temperatures. The results of ionization cross section measurements done previously are also presented. NSA

N69-10605# Uppsala Univ., (Sweden). Inst. of Physics.
INTERNAL CONVERSION STUDIES OF THE 113-keV TRANSITION IN Hf-177
S. Toernkvist, S. Stroem, J. E. Thun, V. Schmidt, and N. Baade May 1968 15 p refs Submitted for publication
(UUIP-590) Avail: Issuing Activity

The multipole mixing of the 113-keV transition in ^{177}Hf was studied by measuring the directional correlations involving K, L_{II}, and L_{III} electrons, and by determining the K-conversion coefficient. All data are consistent giving $\delta = -3.1 \pm 0.6$. Author (NSA)

N69-10608# Technische Hogeschool, Eindhoven (Netherlands).
FORMATION OF SURFACE PEROXOCOMPOUNDS
Johannes Henricus Cornelis Van Hoof (Ph.D. Thesis) 1968 76 p refs
Avail: Issuing Activity

Electron paramagnetic resonance (EPR) spectrometry was used to investigate the formation of various oxygen compounds at the surface of TiO_2 (anatase), ZnO, and SnO_2 if these oxides, after a slight reduction, are brought into contact with oxygen at room temperature. Details are given on the instrumentation, and the pretreatment and reactions of the metal oxides. Based on the EPR spectra, it is assumed: (1) The TiO_2 reaction with oxygen leads to the paramagnetic compounds O_2^- and O^- from which only O_2^- is reactive with respect to 1-butene; a reaction with N_2O or NO produces only O^-. (2) At the surface of ZnO and SnO_2, used. (3) The EPR signals of O^- at the surface of the three metal oxides are almost identical with respect to form and g-value. (4) The O_2^- signals also show a similarity as to shape; however, one of the g-values strongly differs from oxide to oxide. The differences between the O_2^- signals are explained by an electrical interaction of the Ti^{4+}, and Zn^{2+}, and Sn^{4+} ions with the chemisorbed O_2^- ions. M.G.J.

N69-10627# European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Center.
ELECTRICAL CONDUCTIVITY, ION MOBILITIES AND TRACER-DIFFUSION COEFFICIENTS IN MOLTEN NITRATES BINARY MIXTURES
S. Forcheri, V. Wagner, and E. Berra Brussels 1968 25 p refs Paper presented at the Convegno Dei Metalli Non Ferrosi, Milan, 8–11 Oct. 1967
(EUR-3907.e) Avail: CFSTI

Some results of the experimental research work relative to the determination of transport parameters in molten salts are described. Electrical conductivity, ion mobilities and cation tracer diffusion coefficients have been measured in molten nitrate binary mixtures (Na-Ti)NO_3, (Na-Rb)NO_3 and (Tl-Rb)NO_3. In some cases density and viscosity measurements were as well carried out. Author

N69-10661# National Research Council of Canada, Ottawa (Ontario).

THE SEPARATION EQUILIBRIA OF MANGANESE-PHOSPHORUS AND OXYGEN BETWEEN IRON MELTS AND FeO–MnO-PHOSPHORUS PENTOXIDE SLAGS IN MANGANESE (II)-OXIDE AT 1470 TO 1790°C [DIE VERTEILUNGSGLEICHGEWICHTE VON MANGAN, PHOSPHOR UND SAUERSTOFF ZWISCHEN EISENSCHMELZEN UND FeO–MnO-PHOSPHORUS PENTOXIDE-SCHLACKEN IM MANGAN (II)-OXYDTIEGEL BEI 1470 TO 1790°C]

Wilhelm Anton Fischer et al 1968 20 p refs Transl. into ENGLISH from Arch. Eisenhuettenw. (Dusseldorf), v. 36, no. 11, 1965 p 791–798

(NRC-TT-1338) Avail: Issuing Activity

The effects of phosphorus content on the distribution equilibria of manganese and oxygen between iron melts and FeO-MnO-P_2O_5 slags were studied in a crucible of manganese (II) oxide. Test results from about 200 melts showed that about 30 minutes were sufficient to attain equilibrium if the phosphorus and P_2O_5 content were close to their equilibrium values, equilibrium being approached from both the slag and the metal sides. G.G.

N69-10692# European Atomic Energy Community, Geel (Belgium). Joint Nuclear Research Center.

THE DEVELOPMENT OF A PURIFICATION METHOD OF LITHIUM

J. Pauwels and K. F. Lauer Brussels 1968 21 p refs

(EUR-4072.e) Avail: CFSTI

A purification method of lithium on a cation exchange resin in 1 M HCl is described. To allow the preparation of lithium containing $\leq$ 50 ppm alkali and alkali earth metals, a special purification of the ion exchanger was needed. A method using batch operations with the tetra lithium salt of EDTA, with 30% hydrochloric acid, and elution with 1 M hydrochloric acid was described. Author

N69-10698*# General American Transportation Corp., Niles, Ill. Research Div.

RESEARCH AND DEVELOPMENT STUDY RELATED TO THE SYNTHESIS OF FORMALDEHYDE FROM CO_2 AND H_2. Final Report

P. Budininkas and G. A. Remus Aug. 1968 72 p refs

(Contract NAS2-3889)

(NASA-CR-73269) Avail: CFSTI CSCL 07C

Formaldehyde is an intermediate in the synthesis of edible carbohydrates from CO_2, O_2 and H_2 derived from crew member metabolic wastes on spacecraft missions. Methods of accomplishing the synthesis of formaldehyde from CO_2 were studied, and the $CO_2 \rightarrow CH_4 \rightarrow CH_2O$ route was selected as the most suitable for spacecraft conditions. The partial oxidation of methane by oxygen was investigated using both solid and gaseous catalysts. The highest formaldehyde yield was achieved with gaseous nitric oxide catalyst; the yield was 2.5% of the methane admitted to a single pass reactor. The feasibility of converting CO_2 into formaldehyde was demonstrated with a recycle system entailing two reactors. A methanation reactor converted feed and by-product CO_2 into CH_4; the CH_4 in turn was oxidized to formaldehyde in an oxidation reactor. With recycling, essentially 100% conversion of CO_2 to formaldehyde was achieved at ambient pressures. The product formaldehyde and water were separated and removed either as solid paraformaldehyde and ice or adsorbed on solid adsorbents. The system is compatible with zero gravity operation. Author

N69-10706 Maine Univ., Orono.

VAPOR PRESSURES OF THE SYSTEM $LiNO_3 + KNO_3 + H_2O$ IN THE CONCENTRATION RANGE 55 TO 1100 MOLAL

Terrance Blaine Tripp (Ph.D. Thesis) 1967 148 p

Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-2124

As part of an investigation of the thermodynamic properties of very concentrated aqueous electrolyte solutions, vapor pressures of the system $LiNO_3 + KNO_3 + H_2O$ have been measured by a differential transpiration method in the concentration range from 0.05 moles H_2O/mole NO^-_3 to 1.0 moles H_2O/mole NO^-_3 at temperatures between 119C and 150°C. The composition of the solvent salts was varied from 0.45 moles Li^+/ mole NO^-_3 to 0.70 moles Li^+/mole NO^-_3. The method of vapor pressure measurement employed differed from earlier applications of the differential transpiration technique in that the temperature of the reference liquid (pure water) was maintained at an appreciably lower temperature (approximately 65°C) than that of the solution under investigation. This procedure eliminates the necessity of having a solution of known vapor pressure behavior for reference and introduces considerable versatility into the technique. Dissert. Abstr.

N69-10710*# Stanford Univ., Calif. Dept. of Chemistry.

NEGATIVE ION STABILITY CALCULATIONS. Final Report

Henry F. Schaefer, III and Frank E. Harris 15 Sep. 1968 11 p refs

(Contract NAS2-4882)

(NASA-CR-73272) Avail: CFSTI CSCL 07D

Energies of the ^3P and ^1D states of N^- have been calculated using a first-order wavefunction designed to include the strongly structure-dependent part of the correlation energy. Comparing the N^- calculations to those of other appropriate systems, the remaining correlation energy is reliably estimated and the ^1D N^- state is predicted to be metastable, lying 0.844 eV below the ^2D state of N. Instability of the ^3P N^- state is predicted. Author

N69-10715# Edsel B. Ford Inst. for Medical Research, Detroit, Mich. Div. of Nuclear Spectroscopy and Radiation Physics.

POLYCHROMATIC AND MONOCHROMATIC X-RAY ABSORPTIOMETRY USING BETA EXCITED, ELECTRON CAPTURE AND OTHER ISOTOPIC X-RAY SOURCES. Final Report, 1 Sep. 1965–14 Jul. 1968

Luther E. Preuss, William S. Toothacker, and Claudius K. Bugenis May 1968 81 p refs

Contract AT(11-1)-1239

(COO-1239-16) Avail: CFSTI

Solution absorptiometry was studied with x rays from beta excited x-ray sources. Since beta excited x-ray sources produce a bremsstrahlung continuum as well as the characteristic (monochromatic) x-rays of the beta absorber, the effective value of the absorption coefficient decreases with increasing amounts of absorbing material, due to a hardening of the continuum. Hence a graphing of $\ln I_0/I$ versus concentration of solute (the slope representing the sensitivity of the absorptiometry process) provides a nonlinear plot; where I_0 is the intensity of x rays after they have traversed the sample cell and solvent; I is the intensity after passing through cell, solvent, and solute. A study of this typical polychromatic absorption technique and also two methods in which only the K doublet energy is employed in the absorption process are discussed. By these two techniques, a straight line plot of $\ln I_0/I$ versus solute concentration, as is characteristic of monochromatic absorptiometry, is achieved. Author (NSA)

N69-10726# New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry.

COMPUTER SIMULATION OF HOT-ZONE REACTIONS

Vincent C. Anselmo, Theodore King, and Theodore Rekart 2 Aug. 1968 7 p

(Contract AT(11-1)-1618)

(COO-1618-7) Avail: CFSTI

A computer simulated model is being developed that will provide not only a rationalization for the final chemical products from recoil reactions, but should also be useful in explaining

isothermal annealing and solvent effects. The chemical system studied was neutron-irradiated ammonium hypophosphite. This model represents an attempt at simulation of reactions in the hot zone.
NSA

N69-10727# Technische Hogeschool, Eindhoven (Netherlands). Afdeling der Elektrotechniek.
IDENTIFICATION IN COMPLEX VOLATILE ORGANIC MIXTURES. PART ONE: AN INVESTIGATION OF BERGAMOT OIL. PART TWO: GASCHROMATOGRAPHIC IDENTIFICATION
Johannes Jacob Walraven (Ph.D. Thesis) Oct. 1968 143 p refs
Avail: CFSTI

A separation scheme is proposed for identifying a compound down to a predetermined level of concentration, based on the premise that a selective separation scheme has to precede the multistage chromatographic analysis and that structural elucidation should be based on the spectra of the isolated compounds. Using bergamot oil as an example, it is shown that by the application of molecular distillation, extraction, group separation on silica gel, and fractional distillation, many fractions are obtained suitable for preparative gas chromatography. Studies were also conducted on the relationship between structure and gas chromatographic retention on two stationary phases of different polarity. Logarithmic retention functions are used throughout with a preference for the retention index. It is shown that polarity has several dimensions and, by using at least two of these dimensions, relationships can be established between the structure of the stationary phase and the retention characteristics.
M.G.J.

N69-10741# Mound Lab., Miamisburg, Ohio.
THE DIRECT DETERMINATION OF IRON AND URANIUM BY CONTROLLED-POTENTIAL COULOMETRY
D. R. Bohl and D. E. Sellers 5 Sep. 1968 8 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1543) Avail: CFSTI

A method was developed for the direct determination of iron and uranium in mixtures by controlled-potential coulometry. A solid-state controlled-potential coulometer designed and built at Mound Laboratory was utilized. The coulometric titrations were performed using a mercury cathode as the working electrode. The iron and uranium were titrated by controlling the potential of the mercury cathode at −0.04 and −0.35 V, respectively, versus the saturated calomel reference electrode. The iron and uranium contents of the sample were calculated using the integrated electrolysis currents and Faraday's law. Aliquots of a saturated iron-uranium mixture, containing 1.92 mg of iron and 1.21 mg of uranium, were titrated using the recommended method. The accuracy and relative average deviation of the iron determination were −0.09 and ±0.11%, respectively. The accuracy and relative average deviation of the uranium determination were +0.08 and ±0.30%, respectively.
Author (NSA)

N69-10742# Argonne National Lab., Ill.
LABORATORY INVESTIGATIONS IN SUPPORT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 19: REACTION OF BROMINE PENTAFLUORIDE WITH SELECTED COMPOUNDS OF URANIUM AND PLUTONIUM
R. L. Jarry, J. J. Stockbar, and M. J. Steindler Mar. 1968 43 p refs
(Contract W-31-109-ENG-38)
(ANL-7412-Pt-19) Avail: CFSTI

The use of BrF_5 to selectively remove uranium from mixtures with plutonium was studied. The results show that uranium in mixtures with alumina, plutonium dioxide, and fission product compounds can easily be converted to UF_6 at 350°C or lower using 20% BrF_5 in nitrogen as the fluorinating gas while converting the plutonium only to the nonvolatile PuF_4. The presence of Zircaloy or stainless steel decladding product did not hinder the removal of uranium. Plutonium could be satisfactorily converted to PuF_6 by a second fluorination step at 500° to 550°C using elemental fluorine. The kinetics of the reaction of BrF_5 with UF_4, UO_2F_2, U_3O_8, UO_2, and UO_3 were determined; and activation energies of 16.9, 8.3, 9.2, 7.5, and 7.7 kcal/mole, respectively, were derived. Values of the coefficient n for the pressure term in the equation $k' = Ae^{-E/RT}p^n$ of 0.38, 0.71, 0.90, 0.84, and 1.05 were derived for the reactions with UF_4, UO_2F_2, U_3O_8, UO_2, and UO_3 respectively.
Author (NSA)

N69-10769# California Univ., Berkeley. Lawrence Radiation Lab.
A CHEMICAL SECTIONING METHOD FOR THE MEASUREMENT OF SMALL DIFFUSION COEFFICIENTS IN SOLIDS
R. F. Steiger and T. R. Steel Jul. 1968 18 p refs
(Contract W-7405-ENG-48)
(UCRL-18345) Avail: CFSTI

A mathematical analysis of diffusion measurements in silver bromide, obtained by a chemical sectioning method, may lead to a more general application of this simple experimental technique for the determination of small (10^{-10}–10^{-14} cm^2s^{-1}) diffusion coefficients in solids. The mathematical treatment, which involves the exact solution of Fick's law, can be used to establish optimal experimental procedures for the measurement of small diffusion coefficients within a relatively short period of time.
Author (NSA)

N69-10771# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
THERMODYNAMIC AND TRANSPORT PROPERTIES OF HELIUM AND NITROGEN
B. L. Pierce May 1968 79 p refs
(WANL-TME-1753) Avail: CFSTI

Digital computer programs coded in FORTRAN IV language that are used to calculate the thermodynamic and transport properties of molecular helium and nitrogen are described. The programs are oriented toward heat transfer and fluid flow calculations. The results of property calculations cover the pressure range from 1 to 2500 psia and temperature ranges of 35 to 4500°R for helium and 120 to 4500°R for nitrogen. Instructions for the use of the programs are provided and a tabulation of property values is included.
Author (NSA)

N69-10772# IIT Research Inst., Chicago, Ill. Dept. of Physics.
EVIDENCE OF COLLOIDS IN THE BELOW 1°K THERMAL CONDUCTIVITY OF γ-IRRADIATED KCl
R. A. Guenther and H. Weinstock Aug. 1968 4 p refs
Presented at the Conf. on Low Temp. Phys., St. Andrews, Scotland
(Contract AT(11-1)-1629)
(COO-1629-8; CONF-680808-5) Avail: CFSTI

Measurements of the thermal conductivity of γ-irradiated KCl at 0.4 to 4°K were used to test a model of the radioinduced defects, in which aggregates of interstitial chlorine (colloids) are formed by irradiation. An equation for the temperature dependence of thermal conductivity is presented in terms of point defects and larger scatterers. Results for room-temperature γ irradiations are found to agree with curves calculated using a colloidal scatterer radius of 70 Å; scattering by point defects varies with the F-center concentration, and the colloid number is proportional to the total dose. Differences from crystal purity are found to be due to differences which existed in the crystals before irradiation. Results are also presented for 77°K irradiations with and without warmup before the measurements; they indicate that 77°K irradiations produce scatterers of large size which are annealed at 296°K.
NSA

N69-10793 Cincinnati Univ., Ohio.
ANALYSIS OF CONTINUOUS FLOW TUBULAR REACTORS
Lawrence Lewis Upson (Ph.D. Thesis) 1967 356 p
Avail: Univ. Microfilms: HC $18.20/Microfilm $4.55 Order No. 68-2023

The work reported herein investigated two new experimental methods which obtain data much more rapidly than current methods while using very simple experimental techniques. The first method studied utilized steady-state temperature measurements of a reacting gaseous system flowing through a tubular reactor. The reaction rate information was obtained by coupling mass and energy balance equations and solving for the reaction rate term. The second method was intended to extend the thermodynamic analysis technique to the analysis of transient conditions. Transient data resulting from a ramp type perturbation was analyzed using an approach designed to convert the transient temperature measurements into data simulating steady-state conditions. Due to thermal interactions with the mass of the reactor, the approach was unsuccessful. However, a solid basis for future work in this area has been established.
Dissert. Abstr.

N69-10801*# National Aeronautics and Space Administration, Washington, D. C.
NEW ADDITION REACTIONS OF ACRYLONITRILE AND VINYL METHYL KETONE [NEUE ANLAGERUNGSREAKTIONEN DES ACRYLNITRILS UND VINYLMETHYLKETONS]
Dr. Wagler Nov. 1968 13 p refs Transl. into ENGLISH from German report, 21 Apr. 1941
(NASA-TT-F-11925) Avail: CFSTI CSCL 07C

Double bonds with a neighboring unsaturated group can add ammonia, primary and secondary amines, alcohols, phenols, water, hydrogen sulfide and mercaptans. The addition of ammonia was investigated, although only small yields of β-aminoproprionitrile were obtained under experimental conditions. Since acid amines react with formaldehyde, an attempt to investigate their additivity to acrylonitrile was made. Aside from the higher temperature required for initiation of the reaction, the addition to acrylonitrile is as easy as in the case of the amines. This is particularly true for the higher members of the series. Although the expected uniform reaction process of addition of only one mole of acrylonitrile to one mole of acid amide does not always occur, it is always possible to include uniform monoaddition products of acrylonitrile by using a relatively small excess of the amide. The question of additivity of imides was also investigated. A pronounced capability of addition to acrylonitrile was observed.
Author

N69-10808# Argonne National Lab., Ill.
THE MICROCALORIMETRIC STUDY OF THE UF_4–UF_6 SYSTEM [SUR L'ETUDE MICROCALORIMETRIQUE DU SYSTEME UF_4 –UF_6]
Paul Barberi et al Aug. 1968 15 p refs Transl. into ENGLISH from French Rept. CEA-N-916
(ANL-TRANS-654) Avail: CFSTI

The microcalorimetric study of the UF_6–UF_4 system was undertaken in the temperature range 26 to 200°C under various pressures of UF_6. The following conclusions were made. (1) The domains of fluoride stability defined by the Argon diagram was verified. (2) The heat and gravimetric balances, as well as the Debye and Sherrer X-ray diffraction, show that the final product of the UF_6–UF_4 reaction at a temperature of 26° is β UF_5, contrary to the results of Nghi. (3) There is only an apparent contradiction between the results of the thermal differential analysis of Nguyen–Hoang–Nghi and the results reported here. The UF_6 sample seems a little more reactive, and this could not be attributed to a little lower purity, a different specific surface, a much higher pressure of UF_6, or any other reason. It was found that the intermediate fluoride (U_4F_{17} or U_5F_{22}) was formed, and this was confirmed by X-ray diffraction. (4) The AHD peaks that were obtained in the 30 to 80°C zone by the linearly programmed rise in temperature or by successive temperature steps can be attributed to a maximum of the majority reaction onto which certain others are simultaneously superimposed.
Author (NSA)

N69-10821# Japan Atomic Energy Research Inst., Tokyo.
RADIATION INDUCED TERPOLYMERIZATION OF SULFUR DIOXIDE, ACRYLONITRILE, AND OCTENE-1
Masayuki Ito et al Sep. 1968 10 p refs Transl. into ENGLISH from J. Chem. Soc. Japan, Ind. Chem. Sect. (Tokyo), v. 70, no. 6, Jun. 1967 p 1011–1012
(NSJ-TR-133) Avail: CFSTI

The composition of polysulfones obtained was found to be of the form of $(AN)_x$ $(SO_2–Oct)_y$ and the ratio of Oct/SO_2 in the polysulfone was about 1/1, independent of monomer concentrations. Assuming the terpolymerization of this system to be the copolymerization of AN and SO_2–Oct complex C, the following result was obtained: $(C)/(AN) = [\bar{C}]/[AN] \times 20\ [C] + [AN]/[C] + 0.2\ [AN]$, where [C] is concentration of the complex in starting materials and (C) is mole fraction of SO_2–Oct in polysulfone. The polysulfones were soluble in DMF, and became soluble even in acetone or benzene as the contents of AN in the copolymers decreased.
Author

N69-10828# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
NONDESTRUCTIVE DETERMINATION OF THORIA IN SINTERED THORIA-BERYLLIA BLOCKS
K. P. Champion, C. E. Matulis, and R. N. Whittem May 1968 10 p refs
(AAEC/TM-448) Avail: CFSTI

An x-ray spectrochemical method using incoherently (Compton) scattered primary radiation as internal standard is used to correct for bulk density effects, and to provide an almost linear calibration curve for thorium in beryllium oxide–thoria samples.
Author (NSA)

N69-10830# Massachusetts Inst. of Tech., Cambridge.
EXTENSIONS OF THE USE OF Ge (Li) DETECTORS IN INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF GEOLOGICAL SAMPLES
G. E. Gordon, P. A. Baedecker, C. F. L. Anderson, and J.-C. Dran 28 Aug. 1968 9 p refs Presented at Intern. Conf. on Mod. Trends in Activation Analysis, Gaithersburg, Md., Oct. 1968
(Contract AT(30-1)-905)
(MIT-905-125; CONF-681003-4) Avail: CFSTI

The use of Ge(Li) detectors in instrumental neutron activation analysis was extended to very short-lived species and to classes of geological samples not previously studied. Concentrations of Al, Mg, and V were determined in ultramafic rocks and stony meteorites.
NSA

N69-10846# Iowa State Univ. of Science and Technology, Ames.
SUCCESSIVE STEP FORMATION CONSTANTS OF LANTHANIDE 2-PICOLINATES AND α-HYDROXY-α-METHYLBUTYRATES
James William Ingemanson (M.S. Thesis) May 1968 54 p refs
(Contract W-7405-eng-82)
(IS-T-242) Avail: CFSTI

The first, second, third, and fourth formation constants for lanthanide 2-picolinates and α-hydroxy-α-methylbutyrates were determined at 25°C for 0.10 *M* ionic strength. The ratios of the first and second equilibrium constants were determined for both series. These were related to the statistical ratios after an approximation for coulombic and activity coefficient effects were made. The ratio treatment alone indicated bidentate ligand character on 8, 9, or 10 coordinate models for the 2-picolinates. Considering other structural and physical data, it appears most likely that the lighter, larger rare earth cations tend to be 10-coordinated in dilute aqueous media, and that a change to 9 coordination occurs at about the radius

of Gd^{3+}. The ratio treatment coupled with the same physical data indicated that the Δ-hydroxy α-methylbutyrates are constructed from tridentate ligands on a 10 coordinate cation model in the case of the light rare earths and from bidentate ligands on a 9 coordinate model with the heavy rare earths. Author (NSA)

N69-10878# Yeshiva Univ., New York. Belfer Graduate School of Science.

STABLE ISOTOPE STUDIES Annual Progress Report, 15 Jul. 1967–15 Aug. 1968

William Spindel 15 Aug. 1968 29 p

(Contract AT(30-1)-3462)

(NYO-3462-4) Avail: CFSTI

Preliminary studies are reported on the dependence of the fractionation factor for nitrogen exchange in the N_2O_3–NO and HNO_3–NO systems as a function of temperature, pressure, and concentrations. These studies aim at an examination of the feasibility of using a dual temperature process for nitrogen isotope concentration. The temperature dependences of isotopic exchange equilibria of a number of oxynitrogen compounds were examined. Anomalies including inflections, maxima and minima, and crossovers in a plot of log K vs T were found to be fairly prevalent. The significance of the prevalence of temperature-dependence anomalies is discussed. Several approximation methods for predicting isotope effects were tested on the partition-function ratios of a number of oxynitrogen molecules and on the equilibrium constants for exchanges among them. The validity of the various approximation methods was critically examined. Author (NSA)

N69-10909# Rensselaer Polytechnic Inst., Troy, N. Y.

ANISOTROPIC DIFFUSION AND ELECTROMIGRATION Annual Report

H. B. Huntington Jul. 1968 10 p refs

(Contract AT(30-1)-1044)

(RPI-1044-18) Avail: CFSTI

Results of research are reported on Zn electromigration, Ag electromigration, transport in liquid Na–K systems, electromigration of body-centered refractory metals, diffusion of Ag in Zn, and diffusion of Zn in Cd. Results of theoretical studies are included on dynamics of atom motions. NSA

N69-10944# TRW Systems, Redondo Beach, Calif. Quantum Physics Lab.

TRIPLET TO TRIPLET ABSORPTION IN ORGANIC MOLECULES FOR USE IN PHOTOCHROMIC DEVICES Final Report, 31 May 1967–15 Aug. 1968

J. L. Kropp and M. W. Windsor Aug. 1968 72 p refs

(Contract F33615-67-C-1601)

(AD-675323; TRW-08628-6002-R0-00; AFML-TR-68-220) Avail: CFSTI CSCL 7/5

The photochromic properties of several substituted aromatics and heterocyclics have been investigated. The absorption spectra, phosphorescence lifetime T-T absorption spectra and the product of triplet extinction coefficient and triplet formation efficiency, were evaluated for representative compounds. Using these data the photochromic properties of heterocyclics are compared to their hydrocarbon analogs. The values of the maximum triplet formation efficiency are lower for heterocyclics than for aromatics. However, broader T-T absorption and more efficient absorption for pumping light suggest that, on balance, heterocyclics are comparable to aromatic hydrocarbons in their effectiveness as photochromic materials. The variation of solvent induces large changes in the photochromic properties of heterocyclics thus providing a useful additional parameter for adjusting their properties. These differences also promise to shed light on the mechanism of radiationless transitions in these compounds. Recommendations for further studies to improve the photochromic properties of heterocyclics are made. Author (TAB)

N69-10945# Kentucky Univ., Lexington. Dept. of Chemistry.

THE NONDESTRUCTIVE DETERMINATION OF IRIDIUM IN METEORITES USING GAMMA-GAMMA COINCIDENCE SPECTROMETRY

W. D. Ehmann and D. M. Mc Kown 30 Aug. 1968 15 p refs Presented at the Intern. Conf., Modern Trends in Activation Analysis, 1968

(Contract AT(40-1)-2670)

(ORO-2670-28; CONF-681003-6) Avail: CFSTI

A nondestructive procedure for the determination of Ir in meteorites containing at least 0.1 ppM Ir was developed utilizing neutron activation followed by gamma-gamma coincidence spectrometry. NSA

N69-10952# Japan Atomic Energy Research Inst., Tokyo.

RECOVERY OF KRYPTON BY ADSORPTION PROCESS

Susumu Kitani, Seiichiro Uno, Junichi Takada, Hiroshi Takada, and Takeshi Segawa 1968 16 p refs In JAPANESE; ENGLISH summary

(JAERI-1167) Avail: CFSTI

Research designed to obtain data necessary for design of a plant of krypton recovery by adsorption process from the off-gases in spent-fuel reprocessing is reported. The breakthrough of krypton from an adsorption column was measured with ^{85}Kr as the tracer. The adsorption capacity of krypton on various adsorbents, which were eight kinds of activated charcoal and Molecular Sieve AW-500, was dynamically studied. The mass transfer coefficient of dynamic adsorption was calculated by Kawazoe's method. The effects of temperature, pressure, particle size of the adsorbent and carrier gas on krypton adsorption were investigated for an activated charcoal. The applicability of the result in the design of a plant for recovery of krypton and xenon by adsorption process is discussed. Author

N69-10962# Argonne National Lab., Ill. Chemical Engineering Div.

LABORATORY INVESTIGATIONS IN SUPPORT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 17: FLUORINATION OF NEPTUNIUM(IV) FLUORIDE AND NEPTUNIUM(IV) OXIDE

L. E. Trevorrow, T. J. Gerding, and M. J. Steindler Apr. 1968 23 p refs

(Contract W-31-109-eng-38)

(ANL-7385) Avail: CFSTI

Rates of formation of NpF_6 by the reactions of NpF_4 with BrF_3 (6 to 13 m% in nitrogen) or BrF_5 (33 to 35 m% in nitrogen) or fluorine (100 m%) were studied at 250 to 400°C and were interpreted in terms of a rate law that assumes that reaction occurs at a continuously diminishing spherical interface. Correlation of the derived rate constants by the Arrhenius equation yielded activation energies of 20 kcal/mole for the reaction of NpF_4 with fluorine and 26 kcal/mole for the reaction of NpF_4 with BrF_5. Examination of the solid residues from the reactions of NpF_4 with BrF_5 or fluorine by chemical and x-ray-diffraction powder analyses indicated the presence of no species other than NpF_4. The fluorination of NpO_2 by either BrF_5 or fluorine proceeds through the intermediate compound NpF_4. Thus, the fluorination of NpO_2 is analogous to that of PuO_2, which proceeds through the intermediate compound PuF_4, but is not analogous to the fluorination of UO_2, which proceeds through the intermediate compound UO_2F_2. Author (NSA)

N69-10963# Michigan State Univ., East Lansing. Dept. of Chemistry.

RAMAN INTENSITIES OF LATTICE MODES IN MOLECULAR CRYSTALS

J. E. Cahill Sep. 1968 14 p refs Submitted for publication Prepared in cooperation with Princeton Univ., N. J. Frick Chemical Lab.

(Contract N00014-68-A-0109-0003)

(AD-675326; TR-7(32)) Avail: CFSTI CSCL 7/4

A general method of calculating the Raman intensities of lattice modes of molecular crystals, assuming no intermolecular interactions, was developed. The relative Raman intensities of the lattice modes with respect to the internal vibrations for alpha - O2, alpha - N2, CO2 and N2O were calculated within this oriented gas model. The calculated values agree reasonably well with the experimental measurements. Author (TAB)

N69-10969*# Martin Co., Baltimore, Md. Research Inst. for Advanced Studies.
A STUDY OF THE CHEMOSYNTHETIC GAS EXCHANGER Quarterly Report, 14 Jun.–14 Sep. 1968
Leonard Bongers 14 Sep. 1968 25 p refs
(Contract NASw-1596)
(NASA-CR-97743)Avail: CFSTI CSCL 07A

Experiments designed to determine the simultaneous uptake of CO_2, O_2, and H_2 by hydrogenomonads multiplying exponentially in a turbidostat are reported. Gas consumptions of resting cells and of cells growing under batch conditions were determined. Techniques used included polarographic determinations of O_2/CO_2 by the hydrogen depletion method; O_2/CO_2 determinations using a gasometer; dry weight measurements; and determinations of energy conversion efficiency by hydrogenomads from the coupling of the energy derived from the oxyhydrogen reaction with the carbon dioxide fixation process. Results indicate that: (1) not only resting cells but apparently also actively growing cells can affect energy conversion efficiency which is considerably higher than previously assumed possible; (2) an O_2/CO_2 quotient of unity for both CO_2 fixation and generation of new cells indicates that the cell utilizes to the full extent all energy made available by the respiratory chain (assuming a C-fixation pathway via the Calvin cycle and a growth yield of 10); (3) since deficiencies (Mg, Fe) affect the O_2/CO_2 quotient unfavorably and if the conditions in item 2 hold, it is assumed that the conditions under which the high conversion efficiency is obtained represent the optimal conditions for cell growth and cell multiplication; and (4) since the efficient energy conversion could be reproduced routinely and maintained in the experimental culture set-up for any desired length of time, it is assumed that similar conversion efficiencies could also be achieved in a larger, functional unit. S.C.W.

N69-10982*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATIONS OF OXYTRIMETHYLENE-GLYCIN [UNTERSUCHUNGEN UBER OXYTRIMETHYLEN-GLYCIN]
Hugo Kraus Nov. 1968 16 p refs Transl. into ENGLISH from Chem. Br. (Weiheim), v. 51, 1918 p 1556–1571
(NASA-TT-F-11982) Avail: CFSTI CSCL 07C

The specific weight of oxytrimethylene-glycin determined from a preparation containing 13.48% N was found to be 1.348 at 15°/4°, using the suspension method in a well-dried benzol-chloroform mixture, considerably higher than that of glycocoll (1.1607). A solution in formalin or water quickly produces, with spruce pulp, a green-tinged yellow coloration. This results from the Lignin content of the wood; pure cellulose produces no coloring. This reaction can be developed into a rather sensitive test for glycocoll. If a few milligrams of glycocoll, placed on paper with high content of wood, is moistened with a drop of formalin, a noticeable coloration appears in one minute, and a definite green-yellow coloration appears in 3–4 minutes. A somewhat stronger coloration is obtained by using 5% solution of hydrochloric acid; coloration is quickly destroyed by alkalis. If pure water is used, glycocoll at first produces no coloration but when the spot is just dry, a very weak and hardly noticeable yellow coloration results. The alkali-reacting salts of oxytrimethylene-glycin do not produce this reaction. Author

N69-11001# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
THEORY AND TECHNIQUE OF SPARK SOURCE MASS SPECTROMETRY
Rene Stefani Apr. 1968 65 p refs In FRENCH
(CEA-R-3445) Avail: CFSTI

Trace analysis in solids by spark source mass spectrometry involves complicated phenomena such as element ionization in the spark and blackening of sensitive emulsion by the focused ion beam. However, the principal risk of selectivity lies in the analyzer system, which realizes double focusing only for a part of the ions. Therefore, each analyst has to know the ionic optics of this apparatus, for ensuring the transmission of mean energetic ions, which are representative of the sample composition. By a careful photometry of mass spectrum, good reproducibility can be obtained. Therefore, accuracy depends on the knowledge of sensitivity coefficients proper to each apparatus. Author (NSA)

N69-11006# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
AN ANTICOINCIDENCE-SHIELDED Ge(Li) GAMMA-RAY SPECTROMETER AND ITS APPLICATION TO NEUTRON ACTIVATION ANALYSIS
J. A. Cooper, L. A. Rancitelli, R. W. Perkins, W. A. Haller, and A. L. Jackson 2 Aug. 1968 15 p refs Presented at the Intern. Conf. on Modern Trends in Activation Analysis, Gaithersburg, Md.
(Contract AT(45-1)-1830)
(BNWL-SA-2009; CONF-681003-3) Avail: CFSTI

The design and performance of an anticoincidence-shielded lithium-drifted germanium gamma spectrometer with high efficiency, resolution, and Compton reduction are presented. Also, use of the spectrometer in nondestructive activation analysis is illustrated. NSA

N69-11017# General Electric Co., Philadelphia, Pa. Missile and Space Div.
APPLICATIONS OF AVALANCHE TYPE SEMICONDUCTOR RADIATION DETECTORS Annual Report, Jul. 1967–Jul. 1968
Phillip A. Johnston and Gerald C. Huth Jun. 1968 23 p refs
(Contract AT(30-1)-3246)
(NYO-3246-TA-2) Avail: CFSTI

The development of avalanche-type semiconductor detectors for X-ray fluorescence analysis is described. Avalanche detector technology with balanced filter techniques and radioisotope sources are discussed. Avalanche detector response to X radiation is described. Development of an avalanche detector X-ray fluorescence instrument for planetary geochemical exploration, and results obtained with a prototype instrument using a 4 mC polonium-210 alpha emitter and a 1 mC iron-55 x-ray source are discussed. NSA

N69-11024# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
RADIOISOTOPE X-RAY TECHNIQUES FOR APPLICATION TO ON-STREAM ANALYSIS OF MINERAL PRODUCTS
W. K. Ellis, R. A. Fookes, V. L. Gravitis, and J. S. Watt Aug. 1968 22 p refs Submitted for Publication
(AAEC/TM-473) Avail: CFSTI

Radioisotope x-ray fluorescence and preferential absorption methods for analysis of mineral products are described. These techniques were used to determine zinc, copper, tin, and lead in concentrate, flotation feed, tailing, and residue samples taken from mineral processing plants. The precision obtained was in the range 1 to 10% of the mean element concentration except for copper in tailings. The application of these techniques to onstream analysis in mineral processing plants is discussed. Author (NSA)

N69-11032# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Kernphysik.
MIXED CONFIGURATIONS IN Yb^{169}
W. Michaelis, F. Weller, H. Schmidt, G. Markus, and U. Fanger [1968] 51 p refs Transl. into ENGLISH from German
(ORNL-TR-1954) Avail: CFSTI

The level structure of ^{169}Yb was studied by radiative capture of thermal neutrons in ^{169}Yb. High-resolution measurements of the gamma-ray spectrum were performed using a Ge(Li) anti-Compton spectrometer in low-energy region and a Ge(Li) pair spectrometer for the high-energy transitions. More than 300 gamma lines were detected in the spectrum. The high accuracy of the data allows the application of Ritz' combination principle to excitation energies up to 1.5 MeV. The results clearly demonstrate the presence of remarkable band-mixing effects. The neutron binding energy was found to be 6867.21 ± 0.46 keV. Theoretical calculations were performed which take into account pair correlation, quasiparticle–phonon interaction, rotation-vibration interaction, and Coriolis coupling. The energy and structure of individual levels, the ratios of intensities for gamma-ray transitions, and multipolarity admixtures are predicted. In general, good agreement is achieved between the theoretical calculations and the experimental results.
Author (NSA)

N69-11037# Portugal. Nuclear Energy Commission, Sacavem. Physics and Nuclear Energy Lab.
STUDY OF THE CHEMICAL EFFECT OF THE REACTION (n,γ) IN CRYSTALS OF IRRIDIUM HEXACHLORIDE (IV) [ESTUDO DOS EFEITOS QUIMICOS DA REACCAO (n, γ) EM CRISTAIS DE HEXACLOROIRIDATO (IV)]
J. M. Peixoto Cabral (Ph.D. Thesis—Lisbon Univ., 1966) 1967 81 p refs In PORTUGUESE
(LFEN-78) Avail: CFSTI

The electrophoretic behavior of some chloro-aquocomplexes of iridium(IV), using oxidized solutions of the corresponding iridium(III) complexes in 0.01 N HCl, was studied. By comparing the results obtained with the hydrated crystals with those obtained with the anhydrous crystals it was concluded that some reduction reactions occur in the $Na_2IrCl_6 \cdot 6H_2O$ crystals between the recoil fragments and water molecules or species derived from this water. It is also concluded that the presence of water molecules in the crystals inhibits recombination reactions between the recoil fragments and Cl^- ions, which are also produced as a consequence of the recoil. A comparison of the results obtained with the $(NH_4)_2IrCl_6$ and K_2IrCl_6 crystals, which are both anhydrous, indicates that some reduction reactions also occur in the $(NH_4)_2IrCl_6$ crystals between the recoil fragments and species derived from the ammonium ion.
Author (NSA)

N69-11048# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
SOL-GEL RESEARCH AND DEVELOPMENT IN ITALY
M. Ziffero 1968 25 p refs Presented at IAEA Panel on Sol-Gel Processes, Vienna, 6–10 May 1968
(RT/CHI(68)28) Avail: CFSTI

Cursory research on sol-gel started at CNEN early in 1963; the preliminary results obtained on thoria and the increasing interest in fast reactor fuels suggested a larger program. Today a group of approximately twenty is engaged in full time activity on sol-gel development involving an annual budget of approximately $350,000. This sum however does not include the construction of special facilities (such as alpha labs) and the cost of the irradiation programs. Research on sol-gel follows parallel lines which include: basic chemistry of actinides in colloidal solution, mechanism of gelification and sintering, process chemistry and establishment of flow sheets, process development and research on specific unit operations, product evaluation, irradiation testing, economics. A description given of the results achieved along the different lines.
Author

N69-11077# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
CHAFFER: A COMPUTER PROGRAMME TO EVALUATE THERMODYNAMIC DATA FOR CHEMICAL REACTIONS OVER A RANGE OF TEMPERATURES
R. A. Huber Jun. 1968 20 p ref
(AERE-R-5793) Avail: CFSTI

A computer programme CHAFFER is described, which is designed to evaluate various thermodynamic data for any gas–gas or gas–solid reaction over a range of temperatures, given the thermodynamic constants for each species of the reaction. The main features of the programme are the flexible data input format, the extensive diagnostics provided to flag data errors, and the option of checking the stoichiometry of a reaction. This latter facility is at present limited to the C, H, O, N system, but this should cover most envisaged applications.
Author (NSA)

N69-11099# National Lead Co. of Ohio, Cincinnati. Feed Materials Production Center.
[FEED MATERIALS PRODUCTION] Summary Technical Report, 1 Apr.–30 Jun. 1968
R. Burgett, ed. Aug. 1968 16 p refs
(Contract AT(30-1)-1156)
(NLCO-1020) Avail: CFSTI

The heat of formation of Mg_2C_3 was determined to be −75.0 kcal/mole at 1300°K. The formation of an electrically conducting material by the reactions of uranium metal with halide salts in a graphite crucible was investigated. A helium–neon continuous-wave gas laser was used as an illuminating source for an optical microscope. Resolution and contrast were improved.
NSA

N69-11121# Kansas State Univ., Manhattan. Dept. of Chemistry.
[ON IRRADIATION OF METHANE WITH ELECTRONS IN THE 9–50 eV RANGE] Technical Progress Report, 15 Nov. 1967–14 Nov. 1968
C. D. Finney and H. C. Moser Nov. 1968 17 p refs
(Contract AT(11-1)-584)
(COO-584-37) Avail: CFSTI

Methane at pressures of 0.010 to 0.025 torr, was irradiated with electrons possessing kinetic energies in the 9 to 50 eV range. The reactivity of electrons with energies less than the ionization energy was found to be extremely small. At 12 eV the cross section for formation of C_2H_4 and C_2H_6, the principal hydrocarbon products, was found to be less than 3.4×10^{-18} cm^2. At 13.0 eV the cross section was 1.51×10^{-17} cm^2, and above this energy the cross section continued to rise sharply. The effect of energy electron reactivity suggests that the role of subionization energy electrons in radiation chemistry may be minimal.
Author (NSA)

N69-11126# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
MEASUREMENT OF ppμ MOLECULE FORMATION RATE IN GASEOUS HYDROGEN
Yu. G. Budyashov, P. F. Ermolov, V. G. Zinov, A. D. Konin, A. I. Mukin et al. 1968 25 p refs In RUSSIAN
(JINR-P15-3964) Avail: Issuing Activity

Muonic molecule formation rate in gaseous hydrogen was measured. The method was the analysis of the time dependence of muonic deexcitation x rays, originating due to the muon transfer from pμ atoms to the small amount of xenon admixture. The value obtained for the ppμ-molecule formation rate is $\lambda_{pp\mu} = (2.74 \pm 0.25)\ 10^6$ sec^{-1} (at hydrogen density $\rho = 0.070$ g/cm^3).
Author (NSA)

N69-11139# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
DETERMINATION OF THE THERMAL NEUTRON CAPTURE CROSS SECTION OF Sm-148
R. N. Whittem Mar. 1968 9 p refs
(AAEC/TM-443) Avail: CFSTI

The thermal neutron capture cross section of ^{148}Sm was measured by mass spectrometer abundance measurements before and after irradiation of an isotopically enriched sample of ^{148}Sm. A value of 4.73 ± 0.11 barns was found. Author (NSA)

N69-11146# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
A FEASIBILITY STUDY OF THE CONVERSION OF PLUTONIUM HEXAFLUORIDE TO PLUTONIUM DIOXIDE BY CHEMICAL VAPOR DEPOSITION
W. C. Robinson, Jr. and W. R. Martin Aug. 1968 17 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2306) Avail: CFSTI

A program was undertaken to establish the feasibility of converting PuF_6 to PuO_2 in a one-step process by chemical vapor deposition techniques. The process is analogous to the UF_6 conversion process and involves the reaction of PuF_6 vapor, hydrogen, and H_2O. A remote apparatus with facilities for fluorination of PuF_4 to PuF_6 and subsequent conversion of PuF_6 to PuO_2 was designed, constructed, and the feasibility experiments were completed. X-ray analyses of the powder product confirmed the presence of PuO_2 only. Author (NSA)

N69-11149# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.
GAMMA-RAY SPECTROMETER SYSTEMS USING LITHIUM DRIFTED GERMANIUM DETECTORS
P. E. Gibbons and J. H. Howes Mar. 1968 37 p refs
(AERE-R-5703) Avail: CFSTI

A range of germanium detectors up to 50cc in volume has been developed at A.E.R.E., Harwell. The basic features of these detectors and their operational requirements are described. Operation of these detectors gives rise to some problems which must be solved if their potentials are to be fully and reliably achieved. This has involved the design of various types of cryostats, and the development of low-noise pulse amplifiers which can be matched to a detector to give an optimum response. This work leads to the concept of a spectrometer system, constructed from a basic set of components, designed to meet a specific counting requirement. Several spectrometer systems were built and are described in detail. The degree of resolution obtainable has opened up many new areas of work in gamma spectrometry. Particular examples in radiochemical analysis, fuel-element studies, and nuclear physics are described, and a short account of other applications is given. Author (NSA)

N69-11163# European Co. for the Chemical Processing of Irradiated Fuels, Mol (Belgium).
BIBLIOGRAPHY ON APPLICATIONS OF REVERSED-PHASE PARTITION CHROMATOGRAPHY TO INORGANIC CHEMISTRY AND ANALYSIS
H. Eschrich and W. Drent Nov. 1967 101 p
(ETR-211; NP-17410) Avail: CFSTI

One hundred and ninety-six references, with abstracts, are given. The publications cover the work through June 30, 1967. A survey of experimentally important data is attached in the form of a table. Subject and author indexes are included. NSA

N69-11165# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
DESIGN AND FABRICATION OF A SODIUM PURIFICATION LOOP
V. P. Kelly and T. J. Owen Aug. 1968 40 p refs
(Contract AT(45-1)-1830)
(BNWL-812) Avail: CFSTI

The purpose of the Sodium Purification Loop is to prepare Na of known and controlled purity to supply characterized Na for analytical methods calibration, for loading test capsules and loops, and for tests of Na samplers and chemistry instruments in the Fast Flux Test Facility coolant chemistry studies. The design and fabrication of the forced-convection loop rated for nominal flow of 2 gpm and equipped with both a cold trap and a hot trap are reported. NSA

N69-11169# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
EXPERIMENTS ON THE CHEMISTRY OF THE ELEMENT 104-KURCHATOVIUM. 4: CHEMICAL AND RADIOMETRIC METHODS OF ANALYSIS
R. Caletka and M. R. Shalaevskii 1968 23 p refs In RUSSIAN
(JINR-P7-3855) Avail: CFSTI

The methods of radiometric analysis, used in experiments on the development of a fast and continuous method for separation of short-lived products of nuclear reactions, are described. Desorption of the activity from the equipment (which was used to compare the volatility of the element 104 chlorides with those of hafnium, rare earth, and transplutonium elements) and the chemical separation and radiometric identification of plutonium isotopes, transplutonium elements, $^{165,167}Hf$, $^{44,44m}Sc$, and ^{24}Na, are presented. Author (NSA)

N69-11174# Michigan State Univ., East Lansing. Dept. of Chemistry.
THE PRESSURE INDUCED INFRARED SPECTRUM OF METHANE
Shmuel Weiss (Princeton Univ.), George E. Leroi (Princeton Univ.), and Robert H. Cole (Brown Univ.) [1968] 10 p refs Submitted for publication
(Contract N00014-68-A-0109-004)
(AD-675325; TR-3(8)) Avail: CFSTI CSCL 7/4

The pressure-induced infrared absorption spectrum of gaseous methane was observed using a 10m cell and 4-10 atm. pressure in the region 200-550 cm. The intensity can be expressed according to the relation: A(nu) = gamma(nu)d sq), where A(nu) is the absorbance at frequency nu, and d is the gas density. The spectrum is interpreted in terms of rotational transitions in a pair of CH4 molecules possessing a transient dipole moment induced by the octopole moment of the molecule. Author (TAB)

N69-11191# Kyoto Univ. (Japan). Dept. of Nuclear Engineering.
BASIC RESEARCH ON GASEOUS DIFFUSION SEPARATIONS
Kunio Higashi Nov. 1966 116 p refs Transl. into ENGLISH from the Japanese Thesis
(K-TRANS-37) Avail: CFSTI

Studies of the basic aspects of gaseous diffusion separation are discussed. Topics covered include: previous theoretical treatment of gaseous diffusion separation, mechanisms of surface diffusion, separation of a two-component gas with surface diffusion, separation of isotopes by surface diffusion flow, isotope effects on surface diffusion flow, method of selecting optimum operating conditions for gaseous diffusion separation equipment, and flow pattern of gases in gaseous diffusion separation. NSA

N69-11192# New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry.
ON THE CATION EFFECT ON THE DISTRIBUTION OF OXIDATION STATES FOLLOWING RADIATIVE NEUTRON CAPTURE REACTIONS ON AN IONIC SPECIES
Vincent C. Anselmo 13 Aug. 1968 5 p refs
(Contract AT(11-1)-1618)
(COO-1618-9) Avail: CFSTI

Calculations were performed on the influence of the nuclear reactions of the cation on the oxidation states observed following radiative-neutron capture on a particular salt where the anionic species is under scrutiny. Any radiation damage from photons evolved because of the exoergicity of the reaction, or from nuclear decay reactions, including also beta decay, are negligible and should not cause any radiation effect, at least for the irradiation condition described. Author (NSA)

N69-11195#
OPTICAL ABSORPTION CROSS-SECTION OF DIATOMIC MOLECULES
Iu. A. Plastinin [1968] 36 p refs Transl. into ENGLISH from the book "Fizich. Gazodinamika Ionizir. i Khimich. Reagir. Gazov" Nauka Press, Moscow, 1968 p 89-132
Avail: CFSTI

Questions associated with the determination of the optical absorption cross-section of the electronic band system of the molecules N_2, N^+_2, NO, C_2, CN at 2000-12000°K temperatures are considered herein. Overlapping of the rotational lines and vibrational bands of electronic systems of molecules occurs at high temperatures. The absorption cross-section is analyzed under the assumption of complete overlapping of the rotational lines into the vibrational bands. The optical absorption cross-section σ_λ averaged over 50 and 100 Å wave intervals are computed taking into account overlap of the vibrational bands. Using the σ_λ values thus obtained, the vibrational structure of the radiation and absorption spectra of diatomic molecules can be determined. The authors /1/ published part of the computations earlier. A more exact relationship for σ_λ (taking account of the P,R,Q-branches) is proposed herein, and more exact values for the Franck-Condon factors which have recently appeared are utilized. The range of wavelengths in which the σ_λ is calculated for individual electronic systems of diatomic molecule bands has also been extended. Author

N69-11203# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
RADIATION DAMAGE ON CHLORINE FLUORIDES USED BY REPROCESSING OF FAST BREEDER FUEL
H. Parthey Brussels EURATOM 1967 29 p refs
(Contracts EURATOM-006-65-7-RCIB (RD); EURATOM-016-65-1-RAP-B)
(EURAEC-2024; EUR-3799) Avail: CFSTI

Data on potential radiation damage to chlorine fluorides, utilized for fluoride volatility reprocessing of fast nuclear fuel are reviewed. The formation of fluorine by thermal decompositions of chlorine trifluoride predominates over the generation of fluorine by radiation damage on chlorine fluorides. Author (NSA)

N69-11206# Los Alamos Scientific Lab., N. Mex.
CHARACTERISTICS AND APPLICATIONS OF A LARGE SODIUM IODIDE DETECTOR ASSEMBLY
Jack L. Parker, Dale M. Holm, and Barry K. Barnes [1968] 12 p Presented at Intern. Conf. on Modern Trends in Activation Analysis, Gaithersburg, Md.
(Contract W-7405-ENG-36)
(LA-DC-9801; CONF-681003-2) Avail: CFSTI

Response functions were measured for a large sodium iodide double-crystal detector assembly. The assembly, used by itself and in conjunction with lithium-drifted germanium detectors, was studied for applications in activation analysis and gamma spectroscopy. Author (NSA)

N69-11219# Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Chemical Research Labs.
DIVISION OF CHEMICAL PHYSICS Annual Report 1966-1967
1967 48 p
(NP-17448) Avail: CFSTI

Research progress is reported under the following topics: general, spectroscopy, mass spectroscopy, electron diffraction, electron microscopy, x-ray diffraction, solid-state chemistry, theoretical chemistry, instruments and engineering services, and service and collaborative work. NSA

N69-11220# United Kingdom Atomic Energy Authority, Harwell (England).
SURVEY OF THE FIRST SPECTRUM OF PROTACTINIUM
E. W. T. Richards, I. Stephen, and H. S. Wise Jun. 1968 158 p refs
(AERE-R-5731) Avail: CFSTI

The emission spectrum of protactinium was measured from 3 microns to 4,000 Å. Some 14,000 lines have been recorded and about half of these fitted into a level system of some 200 even levels and 300 odd levels. This level system is based on that suggested by Giacchetti (J. Opt. Soc. Amer., 56: 653(1966)), additional levels being confirmed by at least 6 spectral lines. Probable J values are given where possible, and in some cases the limits given in previous work have been reduced. Author (NSA)

N69-11225# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzaumu.
PHASE PURITY CONTROL OF THE SYSTEM U-C-N-O [KONTROLA FAZOVE CISTOTY SLOUCENIN SYSTEMU U-C-N-O]
A. Benadik, I. Krivy, and F. Skvor Apr. 1968 26 p refs In CZECH; ENGLISH summary
(UJV-1962) Avail: CFSTI

Analytical, x-ray, and metallographic methods of the phase-purity control of UC, UN, and U(C,N,O) are described. The greatest attention was paid to the oxygen (vacuum fusion), the nitrogen (vacuum fusion or Kjeldahl method), the carbon (combustion in oxygen stream at 1100°C), and the uranium determination methods. The lattice parameters of UC (a = 4.9572 ± 0.0005 Å), UN (a = 4.8907 ± 0.0005 Å), and U (C,N) were calculated. The algebraic expression for the lattice constant of the pure carbonitrides in the composition range of 0 to 50 mol. % UN was derived. The metallographic examinations gave information about the phase-purity of the materials studied and allowed determination of the free uranium or the metastable uranium dicarbide impurities presented in the amounts 1.5 wt.%. Author (NSA)

N69-11239# Battle-Northwest, Richland, Wash. Pacific Northwest Lab.
SPECTRAL DATA HANDLING SYSTEMS
F. P. Brauer and J. E. Schlosser 11 Jul. 1968 10 p refs Presented at Intern. Conf. on Modern Trends in Activation Analysis, Gaithersburg, Md.
(Contract AT(45-1)-1830)
(BNWL-SA-1976; CONF-681003-1) Avail: CFSTI

Computer systems for handling, analyzing, storing, and retrieving gamma spectroscopy data for neutron activation analysis are described. The systems are in FORTRAN IV for an IBM 7090 and a Univac 1108. NSA

N69-11240# California Univ., Berkeley. Lawrence Radiation Lab.
NUCLEAR MAGNETIC AND NUCLEAR QUADRUPOLE DOUBLE RESONANCE IN SOLIDS
Michael Schwab (Ph.D. Thesis) Jul. 1968 156 p refs
(Contract W-7405-ENG-48)
(UCRL-18278) Avail: CFSTI

Presented is a new scheme for a sensitive nuclear double resonance detection. An ordered quadrupole system (A) is used to both establish and monitor a metastable state of a second abundant spin system (B). Because of the long relaxation time of this metastable state it is possible to perform a sensitive double resonance between the B spin system and a third rare or weakly interacting system (C). This technique was applied to a deuterated

(≈12%) sample of paradichlorobenzene. The ^{35}Cl reservoir acts as the A system. The B proton system has a zero-field lifetime of 46 seconds, and approximately a one-hour lifetime at 135 gauss. The C systems investigated are (1) the deuterium system and (2) the naturally abundant ^{13}C nuclei. The measurements of the deuterium resonance are the first reported for paradichlorobenzene. The double resonance conditions are detailed and discussed with respect to integer spin systems. The formal cross relaxation equations are also given. Author (NSA)

N69-11241# Temple Univ., Philadelphia, Pa. Research Inst.
HIGH TEMPERATURE INORGANIC CHEMISTRY Annual Progress Report, 31 Jul. 1967–31 Jul. 1968
A. V. Grosse and Gary M. Krieg 15 Jul. 1968 30 p refs
(Contract AT(30-1)-2082)
(RITU-1968-14; APR-10; NYO-2082-18) Avail: CFSTI

Developments in the following studies are reported: surface tension of the alkali metals from their melting points to the critical region; thermal diffusivity and Prandtl number of liquid Hg and K from melting point to critical point; empirical correlation of the activation energies for high temperature creep, stress-rupture and self diffusion of solid metals with those for viscosity and self diffusion of liquid metals; equation of state for Cs; electric conductivity of liquid La; reaction of liquid Fe and Co with solid thoria at 2000 to 2500°K; reaction between liquid alkaline earth metals (Ca, Sr, and Ba) with refractory metals (Mo, W, Nb, and Ta); and weightless double lenses of two liquid metals (Ga and Na–K alloy). NSA

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N69-10078 Michigan Univ., Ann Arbor.
A STUDY OF AN INTERDIGITAL ARRAY ANTENNA
Pei-Rin Wu (Ph.D. Thesis) 1967 206 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 67-15727

An interdigital array antenna has been devised and studied in this work as a useful antenna for certain applications. The theory of the linear antenna was used in the theoretical analysis to obtain the dispersion relation for a source free infinite interdigital array. In carrying out this analysis, the antenna-wave theory concept was used. This is essential if Floquet's Theorem is to be applied along with the antenna theory. The approximate solutions were obtained numerically through the use of the digital computer. The input impedance and the radiation pattern were also formulated for a finite array of 2N+1 elements with a voltage source applied between the ground plane and the grounded end of the center element of the array. The expressions were then computed numerically, through the computer, for an approximate solution. It is found that an interdigital array antenna has a fairly wide frequency band for its broadside radiation at low frequencies. Dissert. Abstr.

N69-10137*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
OPTICAL SYNTHETIC SIMULTANEOUS OBSERVATIONS BETWEEN BAKER–NUNN CAMERA STATIONS
A. Girnius and W. L. Joughin 26 Jan. 1968 68 p refs
(Grants NsG-87-60; NGR-09-015-002)
(NASA-CR-97452; SAO Special Rept.-266) Avail: CFSTI CSCL 17H

From the time overlapping sequences of precisely reduced simultaneous satellite observations made by the Baker–Nunn camera, directions were derived from the participating stations to single synthesized satellite positions. To determine these synthetic observations, an auxiliary coordinate system was used to avoid computational difficulties for observations of satellites close to the celestial pole. A least squares fitting of the specified degree polynomial and an interpolation for the median overlapping time (T_0) were made. Synthetic observations, reduced and corrected for the effects of planetary and diurnal aberrations, polar motion, and parallactic refraction, were converted to the terrestrial coordinate system and are expressed in the form of direction cosines. Author

N69-10159# Aeronautical Research Labs., Melbourne (Australia).
RESPONSE OF A BAND PASS FILTER WITH MAXIMALLY FLAT AMPLITUDE CHARACTERISTIC TO A SUDDENLY APPLIED SINUSOIDAL VOLTAGE
K. F. Fraser Dec. 1967 37 p refs
(ARL/I-70) Avail: CFSTI

The sharp wavefront of a suddenly applied sinusoidal voltage will not be transmitted through a band pass filter (even if the frequency of the excitation voltage is equal to the centre frequency of the filter) but will experience initial attenuation. It is the purpose of this report to relate the number of cycles which occur during the build up to full amplitude to the bandwidth of the band pass filter. The case of a filter having a maximally flat steady state amplitude response is considered. Author

N69-10160*# Stanford Research Inst., Menlo Park, Calif.
DUAL FREQUENCY RECEIVER SYSTEM FOR MARINER 1967 TO VENUS Final Engineering Report
Roy A. Long and Boyd C. Fair, Jr. Jun. 1968 105 p Prepared for JPL
(Contracts NAS7-100; JPL-951520; SRI Proj. 5986)
(NASA-CR-97477) Avail: CFSTI CSCL 09F

The dual frequency receiver system designed for radio occultation measurements of the ionosphere and atmosphere of Venus as part of the Mariner 1967 scientific payload is described. Coherent signals near 50 and 425 MHz transmitted from the 150-ft-dish field site at Stanford, California are received and compared aboard the spacecraft. Information relative to the medium through which the signals have traveled is fed to the spacecraft data automation subsystem for transmission to earth. This report covers in detail the design and construction of the scientific instrument. Author

N69-10263# Joint Publications Research Service, Washington, D. C.
RADIO SYSTEM FOR TRANSMITTING AND REGISTERING TELEMETRIC AND RANGING DATA FOR SMALL METEOROLOGICAL ROCKETS
V. I. Yermakov *In its* Collection of Articles on Instr. for Studying Upper Atmosphere 22 Oct. 1968 p 111–131 refs (See N69-10251 01-14) Avail: CFSTI

Consideration is given to the possibility of matching a radiotelemetric system and a system for the radar tracking of a rocket. Also described is the principle of operation of the block diagram of the matched system, the basis for which is the system for radar tracking of the rocket. Circuit diagrams of the onboard and ground apparatus for the matched system and the results of their testing are presented. It is concluded that the matched system can be used in rocket sounding of the atmosphere. Author

N69-10320# Aeronautical Research Labs., Melbourne (Australia).
MICROPHONE PRE-AMPLIFIER FOR USE IN DATA ACQUISITION SYSTEM
K. F. Fraser Feb. 1968 18 p refs
(ARL/ME-291) Avail: CFSTI

A miniature high gain pre-amplifier has been designed to amplify signals from a Shure Model 4888 microphone to a level

suitable for direct connection of the microphone plus pre-amplifier unit to the inputs of either the Ampex Model AR200 Tape Recorder or the Pemco Model 110 Tape Recorder/Reproducer. Author

N69-10458# Federal Aviation Administration, Atlantic City, N. J. Dept. of Transportation.
TEST AND EVALUATION OF VHF/UHF ANTENNAS. Final Report
James G. Dong Nov. 1968 95 p
(NA-68-1; RD-67-60) Avail: Issuing Activity

This report presents results of tests performed at the National Aviation Facilities Experimental Center (NAFEC) to obtain standard reference antenna patterns for existing Federal Aviation Administration (FAA) and selected prototype VHF and UHF air-ground communication antennas and associated investigations to determine the effects of antenna configuration, siting, polarization, mutual coupling, and antenna deicing. Because the transmission line is a primary auxiliary to an antenna system, characteristics of foam dielectric cable were investigated for use in field facilities. Results of the test effort provided standard reference patterns for the antennas investigated. In addition, it was determined that the siting environment was the predominant influence on antenna radiation patterns; dissimilar circular polarized antennas could be vertically stacked to provide the needed decoupling where space limitation was a constraint; antenna heaters were feasible for deicing antenna; and foam dielectric cable reduced transmission line losses. Author

N69-10464*# RAND Corp., Santa Monica, Calif.
RADIO RELAY SYSTEM PERFORMANCE IN AN INTERFERENCE ENVIRONMENT
E. E. Reinhart Oct. 1968 133 p refs
(Contract NASr-21)
(NASA-CR-97571; RM-5786-NASA) Avail: CFSTI CSCL 17B

Consideration was given to the overall effect on output message quality of radio frequency interference and noise at the inputs to the repeaters and the terminal receiver of a radio relay system. Both analog and digital modulated systems are discussed, and equations are given for the output message quality determination for both cases. Relative efficiency between analog and digital transmission links for transmitting telephone channels was compared by plotting the difference in dB between the worst channel output signal-to-noise ratio and the effective input wanted-to-unwanted signal ratio against the ratio of rf bandwidth to information bandwidth. Message quality objectives for telephone and television channels subject to fading are presented for terrestrial and satellite radio relay systems. Message and baseband signal characteristics, analog modulated carriers, and preemphasis and noise weighting are considered. M.W.R.

N69-10481# Battelle Memorial Inst., Columbus, Ohio.
SPECTRAL CHARACTERISTICS OF A RADAR SIGNAL SCATTERED FROM A LARGE, IRREGULARLY SHAPED, ROTATING TARGET
Donald E. Barrick [1968] 24 p refs Presented at USNC/URSI Fall Meeting, Boston, 9–11 Sep. 1968
Avail: CFSTI

The average radar cross section and scattered signal spectrum are derived for a large, irregularly shaped target whose aspect is changing with time. The perfectly conducting target surface is treated as a random variable and the analysis is based upon the physical optics integral; the development here is quite similar to that used in rough surface theory. Computer generated curves are shown for the average radar cross section and signal spectrum assuming a Gaussian description of the target surface. The results should be helpful in predicting and analyzing the return from aircraft, missiles, reentry vehicles, satellites, and planets. Author

N69-10490# Joint Publications Research Service, Washington, D.C.
RESULTS OF 10 YEARS OF INTERNATIONAL COOPERATION IN OPTICAL TRACKING OF ARTIFICIAL EARTH SATELLITES [REZUL'TATY MEZHDUNARODNOGO SOTRUDNICHESTVA PO OPTICHESKIM NABLYUDENIYAM ISKUSSTVENNYKH SPUTNIKOV ZEMLI ZA 10 LET]
A. G. Masevich 24 Oct. 1968 24 p refs Transl. into ENGLISH of a Russian Conf. Paper Presented at UN Conf. on the Study and Use of Outer Space for Peaceful Purposes, Moscow, 18 Jun. 1968
(JPRS-46740) Avail: CFSTI

The need for optical observations of artificial satellites is discussed, along with the programs established to obtain accurate data on the irregularities of the earth's gravitational field, geodesic operations, the appearance of new vehicles, orbital changes of the existing vehicles as they enter the dense atmospheric layers, and the burnup of old vehicles. Five types of optical observations are described: normal visual, reference visual for geophysical observations, photographic observations to solve scientific problems associated with the earth's gravity field and geodetic problems, synchronous photographic observations of satellites for geodesy, and photometric observations of artificial satellites. Details are given on the international organizations participating in the global program, the equipment used, and data compilation methods. M.G.J.

N69-10517# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
ON THE FRESNEL EFFECT IN A MOVING WAVEGUIDE FILLED WITH A DIELECTRIC [UBER DIE MITFUEHRUNG ELEKTROMAGNETISCHER WELLEN IM DIELEKTRIKUM-CEFUELLTEN, BEWEGTEN HOHLLEITER]
M. Tutter May 1968 9 p In GERMAN; ENGLISH summary
(IPP-3/73) Avail: CFSTI

A formula is derived for the phase velocity of a wave travelling along a waveguide filled with a streaming dielectric medium. The medium is assumed to be isotropic in the coordinate system in which it is at rest. It is shown that a motion of the waveguide in its axial direction has no influence on the phase velocity. Author

N69-10581# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ANALYSIS OF DIGITAL AND ANALOG FORMAT SYNTHESIZERS
Bernard Gold and Lawrence R. Rabiner 28 Jun. 1968 42 p refs
(Contract DA-28-043-AMC-02536(E))
(AD-674421; TR-465) Avail: CFSTI CSCL 17/2

A digital formant is a resonant network based on the dynamics of second-order linear difference equations. A serial chain of digital formants can approximate the vocal tract during vowel production. The digital formant is defined and its properties are discussed, using z-transform notation. The results of detailed frequency response computations of both digital and conventional analog formant synthesizers are then presented. These results indicate that the digital system without higher pole correction is a closer approximation than the analog system with higher pole correction. A set of measurements on the signal and noise properties of the digital system is described. Synthetic vowels generated for different signal-to-noise ratios help specify the required register lengths for the digital realization. A comparison between theory and experiment is presented. Author (TAB)

N69-10594# Institute of Electrical and Electronics Engineers, New York.
TRACKING FILTERED LIMITED BINARY DIGITAL SIGNALS IN STRONG NOISE
John H. Painter 19 Sep. 1968 17 p refs
Avail: Issuing Activity

The effects of linear filtering are examined followed by ideal limiting on a deterministic binary digital signal immersed in stationary Gaussian noise. The analysis is made in terms of the expected error signal of a simple feedback system which tracks the signal. A general results is specialized to the case where the received noise is much stronger than the signal. For this case it is found that the effects on the expected error signal of filtering and of limiting are separable. For clarification, numerical results are obtained for an example of a low-pass filtered square wave signal. Author

N69-10600# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
COMPUTATION OF TRANSIENT RESPONSES OF RADAR TARGETS Final Report
Marley E. Bechtel Sep. 1968 120 p refs
(Proj. Pure)
(CAL-UF-2457-E-2) Avail: Issuing Activity

An analytical technique, based upon the geometrical theory of diffraction and Fourier analysis, is developed for the computation of the transient radar responses of cylinders, frustums of cones, and related targets. A modified scattering theory is developed for computing the backscattering from the rear of a cylinder observed with a vertically polarized radar at an aspect angle of less than 40 degrees. Comparison of computations with high resolution measurements of the transient response of a cylinder is presented and demonstrates the accuracy of the techniques developed here. Author

N69-10639* Sylvania Electric Products, Inc., Williamsville, N. Y. Sylvania Electronic Systems.
Ka BAND SOLID STATE TRANSMITTER/DRIVER Final Report
15 Aug. 1968 72 p
(Contract NAS8-20599)
(NASA-CR-98125) Avail: CFSTI CSCL 09F

Program objective was to design, develop, fabricate, and test a prototype, space-qualified, model of a solid state source producing 100 mw cw power at 35 GHz. The source was required to have a long term stability of ± 1 part in 10^7 while traversing the thermal limits of $-20^\circ C$ to $+85^\circ C$, and an output signal-to-noise ratio of 60 dB. One engineering model Ka band solid state transmitter/driver was built and tested. The unit produced a stable crystal-controlled output at approximately 35 GHz of 100 mw. The total DC input power required was 60 watts. The spurious and noise outputs were at least 30 dB below the carrier at 35 GHz. The unit dimensions were 8" wide × 10" long ×5.5" high and overall weight approximately 18 pounds. The unit also contained an FM modulation capability. Author

N69-10707*# Alabama Univ., University. Communication Systems Group.
AM BASEBAND TELEMETRY SYSTEMS. VOLUME 1: FACTORS AFFECTING A COMMON PILOT SYSTEM
Richard S. Simpson and William H. Tranter Feb. 1968 76 p refs
(Contract NAS8-20172)
(NASA-CR-98092; TR-10) Avail: CFSTI CSCL 09F

An analysis of the coherent demodulation in SSB/FM and DSB/FM telemetry systems, having demodulation carriers synthesized from a common pilot, is performed. The analysis concerns demodulation when the entire baseband, including the pilot, is perturbed by tape recorder wow and flutter. The errors present in the demodulated waveform are analyzed, which results in approximate expressions for the error magnitudes. Also, the effect of additive gaussian noise on the pilot is analyzed. The nature of the resultant errors is discussed, and the magnitudes of the errors are expressed as a function of the signal to noise ratio. A set of Appendices is included which outlines related work. Author

N69-10761*# Martin Co., Denver, Colo.
ADDRESSABLE TIME DIVISION MULTIPLEXER SYSTEM (CABLE AND CONNECTOR STUDY) Final Report
R. O. Leighou and J. E. Goodwin Dec. 1967 129 p refs
(Contract NAS8-21178)
(NASA-CR-98058; MCR-67-425) Avail: CFSTI CSCL 09A

Reported are results of reliability studies of single interrogation cables and single data cables used in prototype addressable time division multiplexer system to interconnect several multiplexers to a central control unit. Objectives of these studies were (1) to relate the effects of cables and connectors to the overall reliability of addressable time division data systems; and (2) to make recommendations for the selection of cables based upon maximum reliability, minimum weight, minimum size, and optimum performance. Cables with multiple distributed loads and various terminations (i.e., stubs) were analyzed with respect to applications of transient (pulse) voltages. Analyses are supported by general laboratory tests which demonstrate the properties of four different types of cables in a typical distributed multiplexer system, and which establish criteria for the selection of cables and connectors to fit particular applications. Several system configurations were studied in an attempt to demonstrate overall system reliability, and to show how the system and interconnecting cables affect reliability figures. Comparative data on the effects of adding redundancy and other system complexities on overall reliability are given, and criteria for use in the selection of the desired system configuration and circuitry are detailed. S.C.W.

N69-10791*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Dept.
TEN POINT SIX MICRON OPTICAL HETERODYNE COMMUNICATION SYSTEM. PHASE 4 Progress Report, 1 Nov. 1967–31 Jan. 1968
H. W. Mocker 31 Jan. 1968 48 p refs
(Contract NAS8-20645)
(NASA-CR-98114; Rept.-12044-PR4) Avail: CFSTI CSCL 17B

In the design and construction of a 10.6 micron optical heterodyne communication system, two water-cooled CO_2 lasers were built and tested. The lasers oscillated on a power level up to 4.5 watts in a single frequency and zero-order transverse electromagnetic mode. The lasers are diffraction-limited and have a measured beam spread of 2.4 milliradians. Each laser has a piezoelectric element for transition control; with it, 12 to 14 transitions can be brought into oscillation over a tuning range of 450 MHz. A parameter tradeoff study was made to find the best point of operation. Pressure, excitation, gas mixing ratio, and the transition under oscillation were varied while the output power was measured. The laser amplitude stability was found to be ± 1 percent over several hours. Piezoelectric tuning scans yielded the effective frequency width of oscillation for each transition versus applied transducer voltage. For a strong transition, this width is 40 to 60 MHz and, therefore, sufficient to offset the transmitter and local oscillator by 10 MHz and still allow for sufficient tracking range (± 10 MHz) without experiencing transition jumps on either laser. The heterodyne beat signal from both lasers was obtained on a HgCdTe detector. The short-term fluctuations (1/10 sec) are within 2 parts in 10^{10}. Water-cooling improved the long-term stability to 1 part in 10^8 but produces a simultaneous reduction of the short-term stability as a consequence. Author

N69-10800# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Flugfunk und Mikrowellen.
DESCRIPTION OF A DIGITAL COMPUTING PROGRAM EVALUATING THE TROPOSPHERIC AND IONOSPHERIC ANGLE AND RANGE ERRORS [BESCHREIBUNG EINES DIGITALEN RECHENPROGRAMMS ZUR ERMITTLUNG DES TROPOSPHAERISCHEN UND IONOSPHAERISCHEN WINKEL- UND ENTFERNUNGSFEHLERS]

P. Edenhofer and D. Giesner Oct. 1967 49 p refs In GERMAN; ENGLISH summary
(DLR-MITT-68-17; DVL-738) Avail: CFSTI

The report presented describes a digital computing program (ALGOL) evaluating the angle and range error caused by the troposphere and ionosphere when earth satellites are observed by means of electromagnetic waves. It is shown how to use this program for practical problems. One finds an explanation of the necessary input data and the output data supplied by the program. Finally some characteristic examples are computed indicating the general use of the program. Author

N69-10874*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RADIO-FREQUENCY PERFORMANCE OF AN 85-FT GROUND ANTENNA: X-BAND
Dan A. Bathker 1 Jul. 1968 42 p refs
(Contract NAS7-100)
(NASA-CR-97716; JPL-TR-32-1300) Avail: CFSTI CSCL 20N

The NASA Deep Space Instrumentation Facility 85- and 210-ft paraboloidal ground antennas have previously been demonstrated to operate well below gain limit at S-band. The results of approximately 6 weeks' experimental effort together with supporting studies of an 85-ft paraboloid at X-band are given. Determinations of the aperture efficiency by independent methods are in close agreement and show the system remains below gain limit at X-band. Mechanical perturbations including ordered changes in the paraboloid focal length were evaluated by radio-frequency and machine-reduced field data obtained by civil engineering techniques. Author

N69-10885*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RADIOFREQUENCY TRANSMISSION CHARACTERISTICS OF SEVERAL ABLATION MATERIALS
Melvin C. Gilreath, William F. Croswell, and Stark L. Castellow, Jr. Washington Nov. 1968 41 p refs
(NASA-TN-D-4879) Avail: CFSTI CSCL 20N

An experimental investigation was conducted to determine the transmission loss, and effects upon the radiation patterns and impedance of typical antennas, produced by thermally degraded ablation materials. A cone-shaped model was used, which consisted of a truncated aluminum substructure with flush-mounted antennas over which a thermal-protection test material was bonded. Measurements of transmission loss through several thermal protection materials were made at 2.66 GHz and 9.60 GHz. The dielectric properties of all virgin materials were measured at room temperature. In addition, antenna radiation patterns, voltage standing wave ratios (VSWR), and gain were determined before and after the materials were subjected to the thermal test. It was concluded that, in general, materials which form and retain continuous conductive char layers during thermal exposure produce very high transmission losses. Also, it is shown that antennas which are covered with such high-loss materials may exhibit extreme perturbations in the radiation patterns that are not present when the antenna is covered with the virgin material. The antennas used for this test program experienced an increase in VSWR when covered with the high-loss materials; however, the loss attributable to this mismatch was less than 2 dB. Author

N69-10924# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTIMUM SYSTEM OF SIGNAL DETECTION WITH NOISE MODULATION IN THE PRESENCE OF INCOHERENT RECEPTION
N. M. Malyarevskiy 4 Jan. 1968 16 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Radioelektronika, v. 10, no. 4, 1967 p 335-343
(AD-674890; FTD-MT-24-376-67) Avail: CFSTI CSCL 9/4

Problems are examined concerning the synthesis of an optimal system for separating signals with a single passband noise modulation with a suppressed carrier. It is proposed that the receiver utilize a random method of reception of the type filter-square-law detector--filter and that the useful signals be masked by random reflections operating in conjunction with interference from a fluctuating source. TAB

N69-11011*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELATIONSHIP BETWEEN COMPLEX- AND ENVELOPE-COVARIANCE FOR RICIAN FADING COMMUNICATION CHANNELS
Erwin Mondre Washington Nov. 1968 33 p refs
(NASA-TN-D-4825) Avail: CFSTI CSCL 09D

In practice, the measurement of the covariance function (which characterizes a time and frequency selective fading communication channel) involves envelope detecting the received signals before correlating. Envelope covariance is insufficient for an accurate evaluation of system performance and rather a complex covariance is needed. This paper presents a study of these two covariances for Rician statistics. The general properties of the Rician distribution are discussed. The relationship between complex covariance and covariance of the envelopes of a complex Rician fading communication channel is derived. It includes the well known case of Rayleigh fading. For the assumption of symmetric spectrum of the narrow band random process there exists a monotonic relationship which allows the evaluation of the complex covariance once the envelope covariance is measured. An extension to unsymmetric spectrum is given. The results obtained show that the envelope covariance represents a lower bound of the magnitude of the complex covariance. Author

N69-11043*# Alabama Univ., University. Communication Systems Group.
WAVEFORM DISTORTION IN AN FM/FM TELEMETRY SYSTEM
Richard S. Simpson, Ronald C. Houts, and Fred D. Parsons Jun. 1968 59 p refs
(Contract NAS8-20172)
(NASA-CR-98093; TR-14) Avail: CFSTI CSCL 09F

A method is presented for measuring the waveform distortion in an IRIG FM/FM telemetry channel. The waveform distortion is defined as the minimum rms error between the input data signal and the signal out of the channel after compensating for differences in amplification, dc bias, and time delay. The causes of waveform distortion in the telemetry channel and their relative importance are discussed. An experimental method for measuring the waveform distortion is developed. Results are presented for a typical channel in the form of a family of curves which display the variation of normalized waveform distortion as a function of peak-to-peak input voltage of a wideband signal using the percentage of channel bandwidth occupied by the signal as a parameter. Detailed results for 17 channels in an IRIG System are tabulated. Composite system performance is presented in the form of a curve plotting percentage waveform distortion versus percent channel utilization. This curve gives the user an approximate upper bound on signal bandwidth to insure that the waveform distortion is less than a specified percentage. Also, an average time delay for each channel is measured, and results indicate that the time delay is inversely proportional to the channel bandwidth. Author

N69-11113*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Dept.
TEN POINT SIX MICRON OPTICAL HETERODYNE COMMUNICATION SYSTEM. PHASE 3 Progress Report, 1 Aug.-31 Oct. 1967
H. W. Mocker 31 Oct. 1967 55 p refs
(Contract NAS8-20645)
(NASA-CR-98116; Rept.-12044-PR3) Avail: CFSTI CSCL 17B

Initial experiments were made for the design of improved carbon dioxide lasers with a better long-term stability. The design was proven and construction was started. Electronic components for the communication system were built and tested. These include a complete AFC loop consisting of 10 MHz IF amplifier, limiter, discriminator, and a low-pass filter with variable cut-off frequency between 50 Hz to 2 kHz. Electronic components for CO_2 laser modulation were built and tested. A 50 kHz subcarrier oscillator was built and a 2 MHz oscillator, feasible either for piezoelectric FM or for driving a GaAs mosulator, was built and tested. The optical system in the form of a 4-inch off-axis Cassegrain was designed. Signal, noise, and bandwidth considerations were made which indicate that with lasers of short-term stability of 1 part in 10^{10} a tracking accuracy of 1 part in 10^{11} should be achievable. This implies that the IF is narrow enough to allow the simple baseband modulation. Author

N69-11145# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
LINEAR ANTENNAS IN PLASMA MEDIA
R. J. Lytle and F. V. Schultz Aug. 1968 249 p refs
(Contract N00014-67-A-0226-0004)
(AD-674887; TR-EE68-10) Avail: CFSTI CSCL 9/5

The problems of a gap-excited finite-sized linear antenna, with and without a vacuum sheath, operated in a uniform cold and in a uniform warm lossy plasma medium, have been considered by applying integral equation and boundary value problem techniques. The dependence of the input admittance, the current distribution, and the radiation pattern, upon the collision frequency, the electron temperature, the length of the antenna, the length-to-radius ratio for the antenna, the ratio of the plasma frequency to the operating frequency, and the thickness of a vacuum sheath have been investigated. An integral equation formulation relating the electric field intensity to the current on the antenna, and several boundary value problem formulations concerned with prolate spheroidal antennas, with and without confocal prolate spheroidal vacuum sheaths, have been considered. Admittance curves are given from which the input admittance of a finite linear antenna can be estimated for a wide range of operating conditions and antenna structures. Conductance and susceptance maxima, dependent upon the vacuum sheath thickness, have been observed when using the cold plasma model, for omega < omega sub p. When using the warm plasma model in conjunction with the boundary condition that the normal component of the fluid velocity is zero at the antenna surface or the vacuum sheath surface, the radiation resistance of the antenna, is increased significantly, for the parameters considered. Author (TAB)

N69-11259*# Perkin-Elmer Corp., Norwalk, Conn. Optical Group.
LASER/OPTICS TECHNIQUES Interim Summary Report
Morley S. Lipsett 30 Apr. 1968 136 p refs
(Contract NAS8-20115)
(NASA-CR-98117; Rept.-9365; IR-3) Avail: CFSTI CSCL 17B

Design and manufacturing details are provided on a laboratory prototype communications system, consisting of a laser telescope communications package and a four-axis mount to be operated in conjunction with an earth beacon simulator. The transceiver optical configuration was redesigned to show the feasibility of adapting the system for a transmitter wavelength of 10.6 microns. The key optical components were made reflective and independent of operating wavelength or laser choice. A fine guidance system was developed to combine the optical efficiency of an optical image splitter with the compactness and reliability of a quadrant multiplier phototube. Instrumentation weight was minimized, and the instrument package was made more compact. Also developed was instrumentation for testing laser telescope performance under simulated space conditions. The factors contributing to scattered light are assessed, and criteria are given on selecting substrate materials for infrared and visible dichroic beamsplitters. An overview is included on several solid state modulators proposed for CO_2 laser light. M.G.J.

N69-11290# Joint Publications Research Service, Washington, D. C.
ELECTRODYNAMIC ANALYSIS OF SPECIAL NONUNIFORMITIES IN WAVE GUIDES
M. G. Kuznetsov 18 Nov. 1968 30 p refs Transl. into ENGLISH from Tr. Mosk. Ordena Lenina Aviats. Inst. Im. Sergo Ordzhonikidze (USSR), no. 159, 1964 p 86–110
(JPRS-46889) Avail: SOD/CFSTI

Two forms of special nonuniformities that occur in periodic delay systems of frequency scanning antennas were investigated, namely: (1) a bend in the E plane waveguide by 180 degrees and a change in the cross section at the bend and (2) a series connection of the cavity resonator and waveguide. A general solution is offered in terms of longitudinal magnetic waves, with the field of the waveguide limited by the sides of conducting planes. The method of partial areas is used to solve the bend nonuniformity, which is assumed to decompose into symmetrical and asymmetrical excitation; and details are included for a case with each type of excitation. Formulas are also given for the series connection, and equivalent circuits are considered for both types of nonuniformities. M.W.R.

N69-11294# Joint Publications Research Service, Washington, D. C.
RADAR JAMMING AND PROTECTION OF RADAR STATIONS AGAINST NOISE
P. I. Baklashov 14 Oct. 1968 63 p Transl. into ENGLISH from the book "Spravochnik po Osnovam Radiolokatsionnoy Tekhnika" USSR, Mil. Publishing House, 1967 p 469–524
Avail: CFSTI

Radio reconnaissance of radar equipment and various methods for determining radar station operating frequencies are reported in the context of radar jamming and protection of radar stations against interference. Attention is given to the radio reconnaissance range, and various kinds of radar interference. The correlation function which characterizes fluctuation interferences is discussed, including its principal properties. Noise interference with amplitude, frequency, and combined amplitude-frequency modulation is reviewed; and methods for creating such noise are noted. The suppression coefficient is introduced, and an equation for determining radar jamming is given. Passive interferences, anti-radar camouflage, controlling reciever-channel overloading, and various methods of protection against interference are also discussed. M.W.R.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N69-10022 Illinois Univ., Chicago.
ON THE REALIZABILITY OF QUASI-LINEAR SEQUENTIAL MACHINES
Szu-Chi Chang (Ph.D. Thesis) 1967 68 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-1722

The realizability of quasi-linear sequential machines was studied. For a given coding of the states of a sequential machine, a set of linear relations among the states can be found. A quasi-linear sequential machine preserves these linear relations under state transitions. A necessary and sufficient condition is first established for a completely specified coded sequential machine to have a quasi-linear realization with a minimum number of state variables. The theorem is then extended to uncoded sequential

machines and involves obtaining, by an iterative method, a linear relation among the states and from this relation the generation of others until a number of linear relations sufficient to specify a state assignment has been obtained. A graphical representation of the theorem and an algorithm to synthesize an uncoded completely specified quasi-linear sequential machine from the flow table description are developed. Dissert. Abstr.

N69-10039 Michigan Univ., Ann Arbor.
SIMULATION OF PLANAR MECHANICAL LINKAGE SYSTEMS
Robert Frederick Timm (Ph.D. Thesis) 1967 146 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-17846

The analog simulation yields all kinematic and dynamic information for a linkage system with either a prescribed motion input, as with a mechanism, or with a prescribed force or torque input, as with a machine. Parameters may be easily varied, and variables may be recorded or displayed with the investigator in immediate and direct control of optimization. Generalized procedures are described for devising computer circuits on a modular basis for linkage systems with rigid elements. Examples are given with derivations of the mathematical models and the computer circuits along with samples of computer records. The four-bar crank and rocker linkage is simulated as a mechanism with a prescribed motion input. The kinematic simulation provides the investigator with a visual display of the mechanism, with the ability to make displacement records of the motion of any point on the mechanism (the coupler curves being of prime interest), and to simultaneously record the angular velocities, and accelerations of all links. Dissert. Abstr.

N69-10098*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTE—A TIME-SHARING DESK CALCULATOR PROGRAM
Paul Swigert Washington Nov. 1968 24 p
(NASA-TN-D-4917) Avail: CFSTI CSCL 09B

Introductory details are presented on the COMPUTE program, written primarily in FORTRAN 4, which operates under the IBM 360/67 Time-Sharing System (TSS). The program allows the TSS user to perform various numerical calculations without writing FORTRAN programs. The user may thus solve various numerical problems while at the TSS terminal by simply communicating with COMPUTE. It is anticipated that the user will obtain from this introduction the information necessary to begin using COMPUTE. More specific information about the capabilities of COMPUTE can be derived from the actual use of the program. This is possible because of numerous error, warning, and information messages generated by COMPUTE and printed at the terminal. Author

N69-10182# Maryland Univ., College Park. Computer Science Center.
BASIC FOR THE UNIVAC 1108
George Ohlmacher, Robert Cassels, Thomas Hall, Brian Stanley, and Alfred Beam Sep. 1968 57 p
(Grants NsG-398; NGL-21-002-008)
(TR-68-77) Avail: Issuing Activity

This report describes the BASIC language processor for the UNIVAC 1108 computer, operating under control of the UNIVAC 1108 Executive System. The language processed is simple to learn, yet powerful enough to solve a large class of problems. BASIC was designed primarily for use from low speed remote devices such as tele-typewriters. Interaction with the user is conversational with respect to syntactic errors in statements. Corrections and modifications to programs are easily made. The compiler is re-entrant and occupies relatively few core locations, hence making BASIC one of the most appropriate languages for wide use in a time sharing environment. Author

N69-10244 Illinois Univ., Urbana.
THE VISUAL IMAGE PROCESSOR
John Kenneth Russell (Ph.D. Thesis) 1967 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-1843

An electronic computer which operates on two-dimensional visual images is described. The Visual Image Processor is designed to compute on data obtained from image points and their near neighbors. The number of types of computations which can be performed is very large: computation with both digital (quantized) and analog (continuous) signals is possible. The heart of the computer is three cathode ray electrostatic storage tubes, used as the data storage system. Computation is performed by combining video signals obtained by simultaneously offset scanning the images recorded in two tubes and writing the outcome of operations performed on the two signals as the newly created image in a third tube. This computing process can be repeated indefinitely if noise considerations are minimized. Dissert. Abstr.

N69-10305# Weapons Research Establishment, Salisbury (Australia).
EVALUATION OF THE TRANSFER MATRIX FOR A PHYSICAL SYSTEM
R. G. Seecamp Jan. 1968 20 p refs
(TN-SAD-193) Avail: Issuing Activity

This note describes the methods used in an IBM 7090 digital computer program for the determination of the transfer matrix of a linear, or linearized, physical system with constant coefficients. The numerator and denominator of each element of the transfer matrix are factorized by the program as a product of first and second degree polynomials with real coefficients. These coefficients and the corresponding poles and zeros are evaluated. Also, the frequency responses of the elements for a number of frequencies can be computed if desired. Author

N69-10316*# Rensselaer Polytechnic Inst., Troy, N. Y.
ADAPTIVE SIMULATION USING MODE IDENTIFICATION
Rob Roy, C. H. Schley, and A. R. Axelrod Washington NASA Nov. 1968 70 p refs
(Grant NGR-33-018-014)
(NASA-CR-1179) Avail: CFSTI CSCL 12B

An input–output process model is formulated using only the process operating record; the processes considered have a finite settling time. As the structure of the process is not known, nonlinear and linear processes fall within the class of processes studied. Since the process parameters are not monitored, the overall cause–effect relationship of the model must change, based only on the on-line operating record of the process. The problems of process identification and pattern recognition are examined in relation to the procedures for assigning a given input pattern to a particular category. Methods for adaptive modal construction are described, and some results are presented on the application of the modal learning technique to both linear and nonlinear systems. Adaptive simulation by the method of potential functions is described, along with the method of realizing the algorithm. Aizerman's proof of the convergence of the algorithm for the two-category case is extended to R categories. M.G.J.

N69-10410*# Maryland Univ., College Park. Computer Science Center.
A HIGHER-ORDER LANGUAGE FOR DESCRIBING MICROPROGRAMMED COMPUTERS
Yaohan Chu Sep. 1968 41 p refs
(Grant NGL-21-002-008)
(NASA-CR-97602; TR-68-78) Avail: CFSTI CSCL 09B

This report discusses the application of a higher-order language for describing microprogram controlled computers. The language is symbolic, algorithmic and descriptive. It is concise and precise in describing computer elements, micro-operations, sequences and

microprograms. A simulator has been constructed for simulating microprogrammed computers described in this language. The language is introduced by describing a simple sequence, first in conventional sequential logic control and then in microprogram control. A simple, microprogram controlled computer is then described. The description shows the configuration, the microprogram itself. Results of the simulation of these examples are partly shown.
Author

N69-10456*# Ampex Corp., Redwood City, Calif.
ADDENDUM NO. 1 TO FINAL DEVELOPMENT REPORT
H. Lienhard, J. C. Mallinson, and C. Steele 27 Sep. 1968 83 p refs Prepared for JPL Addendum to N68-15347
(Contracts NAS7-100; JPL-951785)
(NASA-CR-97458; RR-68-22) Avail: CFSTI CSCL 09B

It is proven that the linear superposition of isolated transition voltage pulses (termed pseudo-linearity) can yield precisely the same result as the multibit computer simulation previously described. The factors controlling the isolated pulse shape are discussed. The impact of the pseudo-linearity concept upon the design of linear filters intended to alleviate the pulse crowding effects evident at high bit densities is analyzed. One class of linear filters, termed noise-whitening filters, are calculated in detail. Multibit, 7500 bpi, frequency doubling waveforms are computed with and without filtering. For high signal-to-noise ratios the filtered waveforms demonstrate that nearly all pulse crowding can be removed. Finally, the noise-whitening filters are reduced to simple twelve element passive networks.
Author

N69-10484*# Kansas Univ., Lawrence. Remote Sensing Lab.
A MEDIAL POINT TRANSFORMATION OF TWO-DIMENSIONAL DATA WITH APPLICATIONS TO DATA COMPRESSION AND NOISE REDUCTION
Irvin Edward Youngberg Houston, Tex. NASA. Manned Spacecraft Center Aug. 1967 70 p refs
(Contract NAS9-7175)
(NASA-CR-97620; CRES-118-1) Avail: CFSTI CSCL 09B

A digital approximation of wavefront propagation described by Blum is implemented on a computer to obtain a medial point transformation of two dimensional data. The transformation is found to be greatly affected by noise and therefore unsuitable for pattern recognition. The transformation is shown to be useful for data compression and noise reduction. An aerial photograph taken over Phoenix, Arizona is processed using the transformation.
Author

N69-10489*# Pittsburgh Univ., Pa. Knowledge Availability Systems Center.
[SPECIAL EXPERIMENTAL PROJECTS INVOLVING INFORMATION SYSTEMS AND TECHNOLOGY UTILIZATION] Quarterly Report for Period Ending 15 Oct. 1968
Allen Kent Oct. 1968 10 p refs
(Contract NSR-39-011-076)
(NASA-CR-97609) Avail: CFSTI CSCL 09D

An overview is presented on the research being conducted to investigate means for improving exploitation of indexes, thesaural development to permit improved relevance predictability of searches, and the comparative relevance of search results. Efforts are underway to determine the applicability of the NASA Thesaurus to the pre-thesaural file. An experiment is being designed to test the hypothesis that selected document surrogates can be keypunched in machine-readable form and searched with existing search strategies (with some systematic alteration and/or modification to accommodate the differences in the structure of index terms vs. text terms). Summary information is provided on the data base population and on pilot searches done manually on the experimental file to find parameters to serve as guidelines for the alteration and/or modification of search strategies.
M.G.J.

N69-10644# North American Aviation, Inc., Los Angeles, Calif.
A DATA PROCESSING FACILITY FOR THE XB-70 FLIGHT TEST PROGRAM
E. L. Edwards *In* AGARD Flight Test Instrumentation 1967 p 243-258 (See N69-10532 01-14)
Avail: CFSTI

Principal features and performance characteristics of the ground data processing facility developed for the XB-70 flight test data system are described. The complete facility provides a dual processing capability in that both analog and digital magnetic tape recordings can be handled. Specific features of the analog system and the digital data processing portion of the facility are detailed. Additional data on the digital data computer controller are included. Features and performance characteristics of the data system that were considered to be of prime importance and which were incorporated into its final design configuration were: (1) capability for producing editing records of selected digital data parameters for use by engineering groups in locating test areas of interest; (2) utilization of a small special purpose online computer, to the greatest extent possible, instead of a large centralized computer facility; (3) utilization of the same special purpose computer for operational control; (4) time compression of digital data for efficient high speed plotting; and (5) rapid processing of data to provide short turnaround times between test flights.
S.C.W.

N69-10645# Princeton Univ., N. J. Aerospace and Mechanical Sciences Dept.
STATISTICAL METHODS FOR THE REDUCTION OF DYNAMIC FLIGHT DATA
Gerard J. Born and Enoch J. Durbin *In* AGARD Flight Test Instrumentation 1967 p 259-298 refs (See N69-10532 01-14)
Avail: CFSTI

Described are statistical averaging methods for the conversion, extraction, and reduction of flight test data (transient and random) derived during aerodynamic research and development phases. Focused on are statistical representations of data as time averages, frequency averages, and as probabilities. Representations in the time domain consider autocorrelation and cross correlation functions. Representations in the frequency domain consider Fourier series, Fourier transformation, power spectral density, and cross power spectral density. Probability measures focus on the derivation of probability density functions and ensemble averages which are taken at a fixed time. The mathematical basis for establishing dynamic characteristics of systems (i.e., input-output relationships of a linear, time invariant system) in the time domain, frequency domain, and in terms of probability density is discussed. Techniques used to extract statistical and instrumentation errors during data analysis are also evaluated. The proposed methods can be used in predicting the variance to be expected in any real measurement as a function of the particular average being calculated, and the amount of data available for the calculation. Included are examples of statistical errors occurring during measurements of mean values; correlation function, mean square; power spectral density; and probability distribution.
S.C.W.

N69-10675# California Inst. of Tech., Pasadena. Willis H. Booth Computing Center.
PLEXUS USER'S GUIDE
I. Richer, D. L. Randall, and J. C. Dill Dec. 1967 45 p refs
(Rept.-6) Avail: Issuing Activity

This report contains the information needed to make use of the PLEXUS system for the construction and specification of neural networks, the analysis of output data produced by these networks, and for storage and retrieval of networks and data from libraries. Error checking is incorporated into the programs, and specific indications are given if invalid parameter values are entered or if illegal operation sequences are requested. The neurophysiological models are described and the specification parameters for the

different network components are listed. The system incorporates a graphic display unit. Results of some analysis on data produced by the network are included. G.G.

N69-10683*# Ampex Corp., Redwood City, Calif. Research and Advanced Technology Div.
DESIGN AND DEVELOP A HIGH DENSITY MEMORY SYSTEM Final Report
Heinz Lienhard 22 May 1968 73 p refs
(Contract NAS8-20755)
(NASA-CR-61853; RR-68-13) Avail: CFSTI CSCL 09B

The scope of the present work was to prove the feasibility of producing high density memory planes based on a closed flux structure. Since the digit line density is only fabrication-limited, it was important to show that very fine memory lines can be produced. Digit lines of .5 mil and .25 mil width have been successfully etched: a memory line density of 1000 lines per inch or even more will, therefore, be feasible. The word line density is limited by demagnetization and creep effects. It has been demonstrated that the following bit densities are possible: 1000Å film: 166,000 bits/inch^2 500Å film: 250,000 bits/inch^2 In a two-spots-per-bit configuration these density figures have to be divided by two. Electronic test results were obtained by working with wider digit lines. The memory arrays for electronic evaluation were scaled in a way to give conclusive results for the high density planes. Author

N69-10918# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POLYNOMIAL INTERPRETATION SYSTEM
V. V. Zakharov 8 Dec. 1967 11 p refs Transl. into ENGLISH from Tr. Sibirsk. Fiz. Tekhn. Inst. Pri Tomsk. Gos. Univ. (Tomsk), v. 47, no. 4, 1965 p 5–10
(AD-674893; FTD-MT-24-351-67) Avail: CFSTI CSCL 9/2

The problem of a semiautomatic distribution of the memory of digital computers and the reduction in the memory volume occupied by the operating problem is being investigated. The problem is solved by the method of interpretation programs. The conditions of interpretation are defined as a consecutive decoding and carrying out of individual parts of the problem comprising the original algorithm of the problem coded in the form of a sequence. These blocks are called pseudocommands. The operative memory contains a small volume pseudoprogram. The interpretation system (IS) decodes the pseudooperations of the pseudoprograms. One of the possible versions of the IS for the series three-address digital computer is descibed. The author discusses as objects for the operation of IS fractional-rational functions and polynomials in the Lagrange and Chebyshev form. The principle on which the polynomial interpretation system (POLIS) is based consists of the interpretation of certain operations over the polynomials. POLIS allows fractional-rational functions (F-polynomials). Basic operations within the POLIS are: addition, subtraction, multiplication, differentiation, integration, subtraction of the differences of norms, and the printing of the polynomials and F-polynomials. TAB

N69-10923# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS OF INCREASING INTERFERENCE REJECTION OF COMPUTER PROCESSES
V. V. Mikhaylov 22 Mar. 1968 14 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Inst. Elektromekh. (Moscow), 1965 p 85–92
(AD-675281; FTD-MT-24-339-67) Avail: CFSTI CSCL 9/2

A number of questions concerning the accuracy of computational processes are analyzed. It is noted that at the present time there are two approaches to the problem of accuracy of machine computation. The first consists of isolated analysis of the component errors of the computational process and is directed toward the location of computer algorithms which most accurately correspond to the problem analyzed. The other approach consists of treating failures, breakdowns, algorithmic errors, errors in program compilation, etc., as errors in the computing process as a whole, and the synthesis of computers is performed with consideration of errors in such a manner as to reduce their influence on the results of computation. From these view-points some general methods for designing interference-stable computer processes are explained. The concept of a computer structure is presented and investigated. Certain methods for increasing the reliability and accuracy of computers are analyzed. Author (TAB)

N69-10927# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A COMPUTER FOR THE STATISTICAL ANALYSIS OF SHADOW GRAPHS OF PROCESSES
L. V. Brusentsov et al 18 Apr. 1968 16 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Elektromekhan. (Novocherkassk), 1967 p 399–405
(AD-675264; FTD-MT-24-107-68) Avail: CFSTI CSCL 9/2

The article explains the need for a special computer in complex analysis of random-processes graphs. Characteristics of the newly designed computer are given, which is capable to carry out the following computations: (1) Averaging ordinates (with conversion of ordinates at almost any principle) with sliding interval. (2) Of correlation and mutually-correlation function of the graph. (3) Of dispersion for various intervals of graph averaging. (4) Of curves for distribution of graph ordinates (integral). (5) Of curves for distribution of cycle time elements and of the whole cycle (integral and differential). (6) Introduction of empirical random function (with conversion or without) into analog for simulating various physical processes during real external effects. The computer is fully automated. The computation results are displayed either on registers or on a pointer instrument. TAB

N69-11052# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROGRAM LOGICAL METHODS OF INCREASING THE RELIABILITY OF DIGITAL CONTROL SYSTEM [PROGRAMMO-LOGICHESKIYE METODY POVYSHENIYA NADEZHNOSTI TSIFROVYKH UPRAVLYAYUSHCHIKH SISTEM]
Yu. B. Arkhangel'skiy, V. V. Zhdanovich, and G. P. Chuguyev 26 Sep. 1967 10 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Inst. Elektromekhaniki, Avtomatizirovannyy Elektroprivod (Moscow), 1965 p 167–173
(AD-675232; FTD-HT-23-517-67) Avail: CFSTI CSCL 9/2

Computer errors are essentially random in character, and the authors discuss them from the point of view of the theory of random processes. For the control of information processed by computers, they propose program logic control based on the redundancy of the original and intermediate information. This differs from other cases encountered in various branches of technology where the computer control may be based on comparisons with appropriate standards. The redundancy leads to various control relationships connecting the calculated quantities which may then be verified at the end of each computational cycle. The computer self-control is applied to the specific case of telescope control. A complete block diagram is given of the program logic and test control appropriate for this type of azimuthal rotation control. TAB

N69-11100# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STATIC CARD INPUT DEVICE

A. V. Ivans and A. E. Ivane 22 Sep. 1967 7 p refs Transl. into ENGLISH from Akad. Nauk Latv. SSR, Inst. Elektron. i Vychislitel'noy Tekhn. Avtomatika i Vychislitel'noy Tekhn. (Riga), no. 11, 1965 p 145–147
(AD-675282; FTD-HT-23-781-67) Avail: CFSTI CSCL 9/2

An optical device for reading a single punched card is described. The total lapse time between initiating illumination and recording is 70 microseconds. A sketch and circuit diagram of the device is given. It is recommended for use in industrial control processes where the same card is read repeatedly and since the absence of moving parts should provide high reliability. TAB

N69-11103# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aerospace Research Labs.
GRID 4: A SUBROUTINE FOR THE UNCONSTRAINED MINIMIZATION OF A FUNCTION OF FOUR OR FEWER VARIABLES Final Report
Julius G. Becsey Jun. 1968 24 p refs
(AD-675187; ARL-68-0111) Avail: CFSTI CSCL 9/2

A computer program is described to find unconstrained minima of functions with four or fewer independent variables. The method applied in the program is a modified direct grid search approach and no gradient or finite difference quotient evaluations are needed. The basic advantages of the method are its extreme reliability, accuracy, and independence of scaling conditions and variable interactions. Author (TAB)

N69-11162*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A COMPUTER PROGRAM FOR SIMPLIFYING INCOMPLETELY SPECIFIED SEQUENTIAL MACHINES USING THE PAULL AND UNGER TECHNIQUE
M. M. Ebersole and P. E. Lecoq 15 Nov. 1968 57 p refs
(Contract NAS 7-100)
(NASA-CR-97707; JPL-TR-32-997) Avail: CFSTI CSCL 09B

Details are given on a computer program mechanized to perform the Paull and Unger process of simplifying incompletely specified sequential machines. An understanding of the process is a prerequisite to the use of the techniques presented. This process has specific application in the design of asynchronous digital machines and was used in the design of operational support equipment for the Mariner 1966 central computer and sequencer. A typical sequential machine design problem is presented to show where the Paull and Unger process has application. A description of the Paull and Unger process together with a description of the computer algorithms used to develop the program mechanization are presented. Several examples are used to clarify the Paull and Unger process and the computer algorithms. Program flow diagrams, program listings, and a program user operating procedures are included. Author

N69-11212# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Obinsk (USSR). Fiziko-Energeticheskii Inst.
DEVICE FOR AUTOMATIC READOUT AND PUNCHING OF EXPERIMENTAL DATA [USTROISTVO AVTOMATICHESKOGO S'EMA I PERFORATSII EXSPERIMENTAL'NYKH DANNYKH]
V. P. Bobkov, M. Kh. Ibragimov, and A. K. Papavyants 1967 10 p In RUSSIAN; ENGLISH summary
(FEI-112) Avail: CFSTI

A description is given of a device designed for automatic readout of information from an experimental stand and for converting it to a form suitable for a universal computer. The electrical signals of the measured parameters are connected one after another to an amplifier by a scanning device and enter next the input of an electronic digital voltmeter equipped with a printing accessory. The signals converted into binary-decimal code are punched on cards and used in this manner for further processing in a universal computer. The described device is constructed from standard devices. Author (NSA)

N69-11213*# Radio Corp. of America, Van Nuys, Calif. West Coast Div.
COMPUTER SYSTEMS FOR SATURN GROUND COMPUTER COMPLEX Final Technical Summary Report, Aug. 1964–Aug. 1967
B. E. Kempf Jul. 1967 111 p
(Contract NAS8-13007)
(NASA-CR-98108; TP1571) Avail: CFSTI CSCL 09B

This is the final technical summary report on the fabrication, delivery, and installation of seventeen Saturn SV Ground Computer Systems. This report reviews the scope of the task and the time period of the contract. Included is a list of hardware items delivered. Also listed are contact modifications and deviation requests. A brief functional and mechanical description of each major assembly is given with review of the major program milestones and accomplishments. Problems that occurred during the course of the contract and the efforts made to resolve these problems are described. A description of the configuration management program supplies listings of the documentations. Also included is a description of the reliability program and of the documentation provided in support of this contract. A summary of the installation and checkout of each system together with a description of the problems encountered during installation and checkout is given. Author

N69-11215# Woods Hole Oceanographic Institution, Mass.
A FLEXIBLE COMPUTER PROGRAM FOR EVALUATION OF EMISSION SPECTROMETRIC DATA
Geoffrey Thompson, Frank T. Manheim (Geol. Surv., Woods Hole, Mass.), and Kay Paine Apr. 1968 95 p
(Contracts AT(30-1)-2174; AT(30-1)-3010)
(NYO-2174-74; NYO-3010-23; Rept.-68-26) Avail: CFSTI

A single program was developed, for use with a direct-reading emission spectrometer, to include the following functions for a variety of sample types, excitation methods, and analytical concentration ranges: background correction by linear relation of background at analytical lines to background at other wavelengths; use of background, internal standard, and analytical channels interchangeably; use of either standard dilution or variable composition standards; and standard curve fitting by least squares regression. Curves as high as 6th order can be fitted in order to utilize shoulder and toe areas of these analytical curves without distorting straight-line segments. Corrected sample readout is used as the dependent variable with the coefficients of the standard curve in solving the equation for the unknown concentration. Weak points in the present scheme include sensitivity of the analytical curves to one or a few points which may be greatly in error, for example due to a stenographic mistake; it produces occasional solutions that require that a choice be made. Author (NSA)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N69-10006 California Univ., Los Angeles.
PARTIAL-FLUX SWITCHING IN MULTIAPERTURE FERRITE DEVICES
James Alexander Howard (Ph.D. Thesis) 1967 600 p
Avail: Univ. Microfilms; HC $27.00/Microfilm $7.60 Order No. 68-236

The objective of this dissertation is to investigate analytically and experimentally the application of the two-aperture transfluxor

as the analog memory device for a hybrid-computer system. The overall features sought in the analog memory include a capacity of several hundred memory cells, dynamic range of ± 10 volts, accuracy of 0.1 percent of half-scale, setting speed of 1 millisecond, all solid state and a design which permits economical fabrication of the memory module. The principal obstacle to the implementation of a MAD analog memory is the lack of an adequate model for the device. Consequently, the first part of the dissertation is concerned with the experimental and analytical aspects of partial-switching in a multipath core. The results are practically applied to the design of an FM Transfluxor-Analog-Memory-System which was developed as an integral part of the dissertation research. Dissert. Abstr.

N69-10077 Stevens Inst. of Tech., Hoboken, N. J.
AN INVESTIGATION OF NOISE IN LINEAR CRYOTRON AMPLIFIERS
Kenneth S. Sohn (Ph.D. Thesis) 1967 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-1162

The noise caused by steps or discontinuous transitions in a linear cryotron amplifier is found to be frequency dependent. It has been demonstrated that the steps are thermal in origin. Measurements on gate films were made with a glass substrate and with a single crystal sapphire substrate at a temperature range above and below the λ point of liquid helium. The step-noise has been eliminated by the use of a composite film of Sn–Cu, and by the use of an alloy film of Sn–In. A composite gate film has been used to operate the cryotron amplifier below the λ point. Several advantages of such an operation have been discussed. Finally, it has been proven that the application of an external magnetic field perpendicular to the film surface causes the steps to appear, even in thin films. Dissert. Abstr.

N69-10113# Finnish Academy of Technical Sciences, Helsinki.
AN ANALYSIS OF THE MODULATED FREQUENCY STABILIZER AND OF THE ABSORPTION DETECTOR FOR MICROWAVE REACTION CAVITY MEASURING SYSTEMS USING A NEW DIODE MODEL
Kalevi Kalliomaki (Ph.D. Thesis—Tech. Univ., Helsinki) 1968 48 p refs /*Its* Acta Polytechnica Scandinavica Elec. Eng. Ser. No. 18 (EI-18) Avail: CFSTI

A modulated reaction cavity frequency stabilizer and reaction cavity absorption detector for microwave measuring circuits have been analyzed by a new diode model. This new diode model is a simple analytical function, which is compared with the rigorous model, derived from the exponential function. The new diode model is also compared with the results measured at different frequencies. Author

N69-10250*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
THE EFFECTS OF REACTOR RADIATION ON 22-VOLT SILICON VOLTAGE REGULATOR DIODES
Suzanne T. Weinstein Washington Nov. 1968 24 p refs
(NASA-TN-D-4923) Avail: CFSTI CSCL 09A

Twenty-five silicon voltage regulator (Zener) diodes (S1N2985B) were exposed to reactor radiation to a total fast neutron fluence of $8.2/10^{19}$ neutrons per square centimeter and a gamma dose of $8.3/10^{7}$ rads carbon. The Zener voltage remained essentially constant and the breakdown knee was somewhat softened. The forward and reverse-leakage currents increased, and the forward voltage drop at high forward currents increased. The junction capacitance remained unchanged. Author

N69-10271*# Auburn Univ., Ala. Antenna Research Lab.
INVESTIGATION OF DESIGN OF HIGH VOLTAGE, HIGH CURRENT SOLID STATE SWITCHING DEVICES Final Technical Report
E. R. Graf 24 Apr. 1968 109 p refs
(Contract NAS8-21081)
(NASA-CR-98075) Avail: CFSTI CSCL 09A

The inherent problems associated with p–n–p–n devices like the Semiconductor Controlled Rectifiers (SCR) are discussed, and the problems of variable loads, large transients, and extremely short duty cycles are considered along with the necessary triggering mechanisms to achieve proper switching. When the ratings of a single SCR are exceeded, it becomes necessary to resort to series and parallel operation which introduces many problems related to triggering, load voltage sharing, load current sharing, and heat removal. Design techniques for compensation of these factors are included. A prototype switch capable of switching 10,000 volts and 10,000 amperes in a 30 microsecond duty cycle is designed using SCRs that are presently available. The limitations of these SCRs are discussed, and means to circumvent these limitations are given where possible. Possible changes in SCRs to better enable the device to perform static switching are recommended. These changes vary from moderate modifications to improve the ability of switch moderate powers, to very basic changes that could possibly enable the SCR to compete with very large tubes for static switches. Author

N69-10283*# Texas Instruments, Inc., Dallas.
DEVELOPMENT OF SILICON NITRIDE AND CERMET RESISTORS FOR USE IN A BINARY COUNTER, METAL INSULATOR FIELD EFFECT TRANSISTOR CIRCUIT Final Report, 1 Dec. 1966–31 Mar. 1968
H. G. Carlson, G. A. Brown, V. Harrap, D. L. Dugger, and R. J. Porebsting 31 Mar. 1968 160 p refs
(Contract NAS5-10307)
(NASA-CR-97459; Rept.-03-68-42) Avail: CFSTI CSCL 09A

Properties of dielectric materials applicable to silicon monolithic metal-insulator-silicon (MIS) field effect transistor (FET) circuits were investigated; and a thin film, high sheet resistance, resistor technology compatible with monolithic device integrated circuit technology was developed. Preparation and properties of silicon nitride and construction, characteristics, and stability of metal-nitride-oxide-silicon (MNOS) insulated gate FET's are discussed; and formation and properties of thin film Cr-SiO transistors are detailed. The latter includes experimental results on (1) mass spectrometric determination of vapor species above a heated mixture of SiO-Cr; (2) structure and composition of evaporated cermet films; (3) cermet resistor deposition, properties, and power capability; and (4) the relation of deposition conditions to film properties for individual runs. Chip layout, circuit performance, and evaluation are given for a monolithic MNOSFET cermet binary counter. M.W.R.

N69-10379 Michigan Univ., Ann Arbor.
A STUDY OF d-c PUMPED QUADRUPOLE AMPLIFIERS
Bong Ho (Ph.D. Thesis) 1967 255 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.30 Order No. 67-15636

The purpose of this investigation is to study the electron beam-wave interaction modes and performance characteristics of one type of transverse beam-wave device, the d-c pumped quadrupole amplifier. Several types of dc pumped quadrupole amplifiers having different pump field structures are analyzed and compared using both coupled-mode and electron dynamics methods. A new mode of operation is observed in this study which involves active coupling between a fast cyclotron wave and a positive kinetic power synchronous wave on an electron beam in the region of a quadrifilar helix dc pump field. The conditions for the existence of such a mode of operation and the gain expression are derived from the coupled-mode analysis. Large-signal calculations of the electron trajectories and their energy relations are obtained on a digital computer. Dissert. Abstr.

N69-10648*# National Aeronautics and Space Administration, Washington, D. C.
THE LEADING-EDGE PRINCIPLE WITH PULSE TRANSFORMERS. REDUCTION OF THE CONTROL RESOLUTION BY A LOW NOISE LEVEL HIGH SPEED PREAMPLIFIER [ZUR LEADING EDGE-METHODE MIT IMPULSTRANSFORMATOREN. ERNIEDRIGUNG DER ANSPRECHSCHWELLE DURCH EINEN RAUSCHARMEN SCHNELLEN VORVERSTARKER]
W. Michaelis Oct. 1968 11 p refs Transl. into ENGLISH from GERMAN
(NASA-TT-F-11930) Avail: CFSTI CSCL 09E

The time signal resolution in high speed pulse techniques is studied with particular attention to signal processing by a pulse transformer and a low level preamplifier circuit. The pulse transformer resolution capabilities are discussed for the applications. The effect of a low level preamplifier suitable for high speed signals is considered. A specific 3-stage amplifier is considered, both theoretically and experimentally, and its resolution improvement capabilities are illustrated in a simulated experiment. Author

N69-10711*# Research Triangle Inst., Durham, N. C.
CHARACTERIZATION OF SILICON DIOXIDE FOR A CAPACITANCE-TYPE METEOROID PENETRATION DETECTOR
K. S. Canady, L. K. Monteith, and R. P. Donovan Sep. 1968 41 p refs
(Contract NAS1-7949)
(NASA-CR-66712) Avail: CFSTI CSCL 01A

Large area metal-oxide-silicon (MOS) capacitors have been fabricated and evaluated electrically and environmentally for use as micrometeoroid counters in space. The conclusion is that the present technology is capable of building capacitors suitable for performing this function. Capacitors were fabricated with dielectric thicknesses from 2000 Å–10,000 Å. These capacitors can be electrically stressed in excess of 10^6 V/cm and have been tested in air and vacuum at −150°C to +300°C without adverse effects. Author

N69-10753*# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Electrical Engineering.
STUDY OF SEMICONDUCTOR HETEROJUNCTIONS OF ZnSe, GaAs AND Ge Semiannual Progress Report, Period Ending 30 Sep. 1968
A. G. Milnes and D. L. Feucht Nov. 1968 32 p refs
(Grant NGR-39-087-002)
(NASA-CR-97737) Avail: CFSTI CSCL 09A

Semiconductor heterojunction transistors of GaAs/Ge and ZnSe/Ge are being studied to determine the parameters controlling gain and frequency response. These parameters include the emitter and base doping levels, the device geometry and the device processing. The growth processes under study include HCl close-spaced transport of GaAs and ZnSe, iodine transport of Ge, and solution-growth of Ge from Zn. The optical properties of ZnSe/Ge or GaAs/Ge photodiodes and photo-transistors are to be examined and are expected to offer attractive features such as window effect. If the progress of the work allows, studies will also be made of nZnSe/pGaAs heterojunctions. Author

N69-10849# Joint Publications Research Service, Washington, D. C.
MPM-7 THIN FILM MAGNETIC MATRIX MEMORY [ZAPOMINAYUSHCHEYE USTROYSTVO NA MAGNITOPLENOCHNYKH MATRITSAKH MPM-7]
Ye. F. Berezhnoy et al 13 Nov. 1968 85 p refs Transl. into ENGLISH from Russian
(JPRS-46863) Avail: SOD/CFSTI CSCL 09A

A thin-film magnetic memory consisting of four MPM-7 magnetic film matrices is described. The memory cycle time is 600 nanoseconds and the capacity is 64 56-bit words. The circuit diagrams are presented for the current drivers and the signal amplifier. The operation of the control unit is described, and the adjustment and test modes of operation of the memory are investigated. Author

N69-10912# Sandia Corp., Albuquerque, N. Mex.
ELECTROMECHANICAL OSCILLATOR DEVELOPMENT REPORT
Jack D. Cyrus Aug. 1968 30 p
(Contract AT(29-1)-789)
(SC-DC-68-2396) Avail: CFSTI

The electromechanical oscillator (EMO) is a small (0.25 cubic inch), low power (100 microwatt average), low frequency (3 to 400 Hz), accurate (±0.3%), transistorized, electrically-driven springmass oscillator. It has possible uses in devices that require an accurate, low frequency pulse generator, such as a timer or a programmer. It can also be used as a prime mover to drive, at a constant rate, a gear train to close a switch or to move the hands of a watch. Author (NSA)

N69-10940# Institut fuer Plasmaphysik G.m.b.H., Garching (West Germany).
PROPERTIES OF IGNITRONS FOR 20 kv CAPACITOR DISCHARGE CIRCUITS
J. E. Gruber Aug. 1967 34 p refs
(IPP-4/44) Avail: CFSTI

The properties of pulse ignitrons are discussed. Measurements of delay, jitter, tube resistance, and heating were carried out. In a reference list different makes of size A ignitrons as well as some of the larger diameter ignitrons are compared with respect to their pulse behavior. Author (NSA)

N69-10961# Harry Diamond Labs., Washington, D. C.
RUGGEDIZED QUARTZ OSCILLATOR CRYSTALS FOR GUN LAUNCHED VEHICLES
F. T. Liss and J. F. Richardson Jul. 1968 26 p
(AD-675486; HDL-TM-68-23) Avail: CFSTI CSCL 9/5

HDL has developed a hermetically sealed quartz oscillator assembly, capable of withstanding gun-launch accelerations up to 70,000 g. This assembly, which employs a pressure-mounted crystal, is intended for use in high-g telemetry systems that encounter extreme shock environment in research and fuze-testing applications. The optimum design may be miniaturized to a 0.400-in. by 0.250-in. package. This report describes the various techniques investigated during this development and the degree of ruggedness obtained. Author (TAB)

N69-11057# General Dynamics/Convair, San Diego, Calif. Space Science Lab.
INVESTIGATION OF ELECTRODE EROSION IN HIGH CURRENT ELECTRIC ARCS Interim Report, Feb. 1967–Mar. 1968
Rolf Dethlefsen Wright-Patterson AFB, Ohio ARL Jun. 1968 62 p refs
(Contract F33615-67-C-1386)
(AD-675185; ARL-68-0112) Avail: CFSTI CSCL 20/3

Experiments on electrode erosion due to magnetically driven high current arcs are described together with a review of the literature. The range of parameters is: arc current 2 to 30 KA, pressure in various gases up to 4 atm, magnetic field strength up to 6 KG. The arc travels in a uniform magnetic field between segmented rail electrodes. The self-magnetic field of the current feed rails is reduced to a negligible level. Measurements of the arc velocity are given. Test plates of various metals are placed between the electrode rails. They are traversed by the moving arc so that the plates are exposed to the anode attachment on one side and to the cathode attachment on the other side. The thermal and electrical properties of various electrode metals have been compiled.

The relative erosion resistance of the metals is evaluated. High-speed photos have indicated that the moving arc attaches in one or several simultaneous attachment spots at anode and cathode. The lifetime of these attachment spots was found to be in the range from 1 to 20 microseconds on copper electrodes. They emit a high velocity jet of plasma which influences the stability and propagation of the travelling arc. Author (TAB)

N69-11059# Harry Diamond Labs., Washington, D. C.
COMPUTER STUDIES OF GUNN OSCILLATIONS IN GALLIUM ARSENIDE
J. L. Scales and A. L. Ward Aug. 1968 49 p refs
(AD-675488; HDL-TR-1403) Avail: CFSTI CSCL 9/5

Gunn oscillations in gallium arsenide were simulated dynamically on a computer. By using different doping profiles, it was possible to simulate different modes of oscillation; e.g., the dipole and charge accumulation mode. Other space-charge configurations, which can exist in principle, would not nucleate spontaneously and repetitively in the computer simulation. The analysis was one-dimensional. The important nonlinear function expressing electron velocity as a function of electric field was assumed known in advance; no attempt was made to derive it as part of the analysis. In fact several different functions were used in order to determine what effect a change in v(E) function would have on the oscillations. The two modes mentioned above were also studied to determine the effects of changes in doping level, bias voltage, and interaction with the external circuit. With more than one nucleation center present in a sample, it was found that the center nearest the cathode tended to control the oscillation. The computer simulation gave qualitative verification to theoretical rules such as the minimum density-length product rule, and the equal area rule. In addition a maximum density-length product was found for accumulation mode oscillations. Also a type of high frequency oscillation was found to occur at a voltage just below the threshold for normal dipole oscillations. Author (TAB)

N69-11063# Harry Diamond Labs., Washington, D. C.
A STUDY OF THE SYNCHRONIZATION OF TWO OSCILLATORS
Carol A. Roberts and Almis Vitenas Jun. 1968 43 p refs
(AD-675487; HDL-TR-1397) Avail: CFSTI CSCL 09/3

Expressions for the lock-in response and beat frequency waveform for the case of two interacting oscillators were derived. Because beat waveforms are nonsinusoidal, a mean shift occurs outside lock-in that gives rise to a low frequency voltage at the detector. The frequency of this voltage is a function of the rate of change of the distance between the two oscillators. If the frequency falls in the signal band, undesired responses will be observed. Bounds were also determined for the magnitude of the voltage due to this interaction effect and have noted that oscillators can be designed to minimize this voltage by choosing the proper values of compliance coefficients. Author (TAB)

N69-11071# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS FOR THE DETERMINATION OF THE APPROXIMATE VALUES OF THE AGING TIME AND SUBSTITUTION TIME OF ELEMENTS
L. P. Leont'yev 9 Nov. 1967 10 p Transl. into ENGLISH from Avtomat. Vychisl. Tekh. (Riga), no. 11, 1965 p 193-198
(AD-675229; FTD-HT-23-901-67) Avail: CFSTI CSCL 09/3

A method is described for the determination of approximate aging times and substitution times of electronic elements. It is based on the minimization of the loss function. For certain simple types of distribution (e.g., gamma distribution) the theory yields reasonably simple equations for the determination of substitution times and aging times which can be used during reliability determination of electronic equipment. TAB

N69-11093# Eitel-McCullough, Inc., San Carlos, Calif. Eimac Div.
DEVELOPMENT OF LINEAR POWER TUBES Interim Report 17 May-16 Aug. 1968
William H. Sain 16 Sep. 1968 54 p ref
(Contract N00024-67-C-1044)
(AD-675496; TR68-19) Avail: CFSTI CSCL 9/1

Grid voltage-plate current transfer curves were analyzed using computer techniques to determine third and fifth order intermodulation distortion products. A total of five experimental tetrodes capable of 44 kW PEP output were analyzed as well as one standard production 4CV100,000C. Most transfer curves were taken using the operating conditions within the range of the contractual requirements. Some tests, however, were made outside of this allowable range to gather data useful in the design of new models. The data points used to plot the grid voltage, plate current transfer curve are obtained using a grid-pulsed curve plotter. Intermodulation distortion ratios of 45 db third and fifth order were achieved on a modified 4CX35,000 at the 44kW PEP output level. The operating conditions were: E sub b = 12 kv, E sub c2 = 1300 V and I sub bo = 2.8 amperes. Operating the same tube at a lower screen voltage resulted in the same intermodulation distortion ratios at a lower value of zero signal plate current (I sub bo = 2.5 A). Author (TAB)

N69-11096# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELEMENTS AND NODES OF A DDA ON FERRITE-TRANSISTOR CELLS [ELEMENTY I UZLY TSDA NA FERRIT-TRANZISTORNYKH YACHEYKAKH]
G. F. Kucherov et al 19 Oct. 1967 18 p refs Transl. into ENGLISH from the book "Magnitnyye Tsifrovyye Elementy" Moscow, Nauka, 1965 p 201-212
(AD-675247; FTD-MT-24-268-67) Avail: CFSTI CSCL 9/2

A description is given of a line of ferrite-transistor circuits for a digital differential analyzer (DDA) which perform reliably in ambient temperatures varying from -10 to +65C; bias voltage variation of plus or minus 25% away from nominal -15 v; and clock rates up to 150-200 kc. To assure operational flexibility, the ferrite-transistor circuits are designed with single-phase and two-phase clocks. The basic building block is a RC-coupled ferrite-transistor cell which was included in the design of flip-flops, shift registers, counters, ones generators, indicator circuits, time delay circuits and others. TAB

N69-11097# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC FILM LOGICAL ELEMENTS BASED ON DOMAIN MOTION [LOGICHESKIYE ELEMENTY S ISPOL'ZOVANIYEM PEREMESHCHENIYA DOMENOV V MAGNITNOY PLENKE]
N. S. Ivanov 15 Jan. 1968 8 p refs Transl. into ENGLISH from the book "Kibernoticheskaya Tekhnika" Kiev, Naukova Dumka, 1965 p 6-10
(AD-675469; FTD-HT-23-1275-67) Avail: CFSTI CSCL 9/5

The stability of a magnetic film shift register as a function of film geometry, its thickness, and shift pulse characteristics was investigated. An alloy (82% Ni, 18% Fe) was vacuum-deposited on a glass substrate through metallic masks with longitudinal slits 0.5-5 mm wide at 300C; the films formed were 20-160 nm thick. The easy axis of magnetization was established parallel to the slits. The substrate was placed on top of planar aluminum conductors in which the current was directed perpendicular to the easy axis of the magnetic film. The drive conductor was 1 mm wide, and the information shift conductors were 1.75 mm wide and were placed in parallel and spaced 0.25 mm apart from each other. Shifting was done by applying two successive pulses of one polarity to the upper and lower shift conductors and then reversing the current and repeating the same sequence. Best results were achieved

with a film thickness of 80 nm and drive currents exceeding 10 microseconds. For stable operation of the shift register, it was established that the shift currents must be confined to a range of + or -15% with respect to nominal values. Author (TAB)

N69-11114*# Battelle Memorial Inst., Columbus, Ohio.
A SURVEY OF SEMICONDUCTOR MATERIALS AND PROCESSES FOR THICK-FILM FIELD-EFFECT TRANSISTOR FABRICATION
F. W. Duncan, Y. F. Chang, and H. C. Gorton 1968 92 p refs
(Contract NAS1-8077)
(NASA-CR-66713) Avail: CFSTI CSCL 09A

The criteria described were applied to a number of candidate materials (semiconductor, dielectric, and electrode), deposition processes, and device configurations obtained from the TFT literature and elsewhere. On the basis of this analysis, nine specific combinations of materials, processes and configurations appear to have some potential for use in the fabrication of thick-film insulated-gate FET's. These specific combinations or models include staggered, coplanar, and inverted-coplanar structures. Semiconductor deposition processes include the wet chemical deposition of PbS at room temperature, the pyrolytic deposition of CdS at 210 C, the pyrolytic deposition of Si at 1000–1200 C, and the reduction of dielectric $BaTiO_3$ at 900 C to obtain semiconducting $BaTiO_{(3-x)}$. In the nine models SiO_2, $BaTiO_3$, or TiO_2 dielectrics and Au, or Ti electrodes are used with the above semiconductors. Author

N69-11155# Royal Aircraft Establishment, Farnborough (England).
ELECTRONIC EQUIPMENT FOR BLACK ARROW SATELLITE DATA HANDLING
D. W. Allen Oct. 1967 28 p refs
(RAE-TR-67256) Avail: CFSTI

Proposals are made for the use of integrated circuits in Black Arrow Satellite data handling systems. Suitable circuit blocks are in current production and their use should result in higher reliabilities and lower cost than would be expected if the U.K.3 type blocks were used. A representative prototype equipment has been built and operation at the required speeds and accuracies has been demonstrated. Author

N69-11277# Joint Publications Research Service, Washington, D. C.
DESIGN AND PRODUCTION OF MODULES AND MICROMODULES
S. A. Mayorov 18 Oct. 1968 199 p Transl. into ENGLISH of the Book "Proyektirovaniye i Proizvodstvo Moduley i Mikromoduley" Moscow, Mashgiz, 1968 p 3-4
(JPRS-46702) Avail: CFSTI

Fundamentals of design and production of modules, micromodules, and solid state devices are discussed; and practical applications and their problems are considered for these devices. Reliability and cost aspects treated in this textbook, which includes chapters in modules with mounted elements, film circuits with discrete active elements, memory elements in miniature and microminiature devices, and semiconductor integrated devices. Intermodular connection procedures and the possibilities of new techniques for building modules are also discussed. M.W.R.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N69-10007 Stanford Univ., Calif.
NEIGHBORING OPTIMAL CONTROL OF NONLINEAR SYSTEMS WITH BOUNDED CONTROL
Donald Richard Mc Neal (Ph.D. Thesis) 1967 102 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-17461

A specific problem encountered in the drag-free satellite project currently in progress at Stanford University motivated this investigation. In the satellite system, cold gas jets are used to control the satellite about a proof mass in free fall under the influence of only the earth's gravitational force. It has been shown that it is possible to greatly reduce the limit cycle fuel consumption in the presence of noise by using the feedback law derived in this study. The problem of the drag-free satellite is very similar to controlling the attitude of a spacecraft, so the method can also be used for this application. The problem of low-thrust interplanetary guidance is also considered. This feedback scheme is based on controlling the system about a nominal trajectory using the method of second variations. When the optimal control for the nominal trajectory is bang-bang, the variation in control along neighboring trajectories consists of perturbations in the switching times and the final time (if free). Dissert. Abstr.

N69-10010 Cincinnati Univ., Ohio.
ANALYTICAL METHODS FOR A CLASS OF NONLINEAR SYSTEMS
William Stephen Wagner (Ph.D. Thesis) 1967 102 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-15977

The purpose of this dissertation is to investigate a class of nonlinear systems which can be represented by the following differential equation: $\ddot{x} + 2\rho\dot{x} + \omega_o^2 x + \mu f(x) = 0$ with $x(0) = A_o$ and $\dot{x}(0) = 0$ and where $f(x)$ is a nonlinear function of x. The function $f(x)$ is constrained to be an odd function but may be one of three types of odd functions as follows: 1) A single term of the power series, $f(x) = x^n$, where n is an odd integer is referred to as a type (A) function, 2) Nonanalytic odd functions which have derivatives everywhere except at the origin such as $x|x|$ and $x|x|^{1/2}$ are referred to as type (1) functions, and 3) Nonanalytic functions composed of straight line segments such as the ideal relay and the dead zone characteristic are referred to as type (2) functions. Approximate analytical solutions are found for the underdamped system, i.e., $\rho = 0$ for the type (A) functions, the type (1) functions and the ideal relay. Dissert. Abstr.

N69-10050 Arizona State Univ., Tempe.
ELECTRICAL STABILITY OF HIGH SPEED LOGIC CIRCUITS IN LARGE SCALE INTEGRATION
Charles Shelley Meyer (Ph.D. Thesis) 1968 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-1654

With regard to circuit stability, a subcircuit, common to many high speed logic circuits, is first identified. A stability analysis is performed on this subcircuit and the effect of circuit parameters on stability is determined. The results are verified for the case of a high speed logic gate. The question of system stability is studied for two types of interconnection media, LC and RC lines. The LC line approximates the characteristics of the strip line used in conventional systems while the interconnections in large scale integration tend to be RC lines. The system stability conditions are independent of line length since the length is determined by topological considerations. The results can be used to determine how the circuit design can be altered to reduce the magnitude of the negative resistance seen at the input terminals of the logic circuit. If it is determined that the magnitude of the negative resistance cannot or should not be reduced to the point where the circuits are unconditionally stable, then the system stability criteria can be applied to determine whether the system will be stable. In the latter regard, the use of RC lines for interconnecting high speed logic circuits is shown to be advantageous. Dissert. Abstr.

N69-10052 Illinois Univ., Chicago.
PARTIALLY SEPARABLE FUNCTIONS
Thomas Andrew Slivinski (Ph.D. Thesis) 1967 115 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-1857

An extension of the concept of linear separation to generate a wider class of functions is presented. This generalization is affected by modifying the requirements for separation to allow both true and false assignments to reside on the same hyperplane (pseudo-separation) or within the same neighborhood of a hyperplane (marginal separation). Theoretical algebraic properties of partially separable functions are investigated, and the relationship between these and the corresponding properties for separable functions is explored. Neccessary and sufficient conditions for each type of separation are also discussed. A parameter which shows whether a given function is separable, pseudo-separate, or marginally separable is introduced. Integer linear programming algorithms which are guaranteed to minimize the number of true or false assignments on the same hyperplane for pseudo-separation or the number of assignments within the same neighborhood of a hyperplane for marginal separation are presented. A systematic procedure for synthesizing an arbitrary partially separable Boolean function in a network of threshold elements based on these algorithms is developed. Dissert. Abstr.

N69-10073 Virginia Polytechnic Inst., Blacksburg.
A METHOD OF APPROXIMATION FOR THE DETERMINATION OF THE TRANSIENT RESPONSE OF NONLINEAR FEEDBACK CONTROL SYSTEMS
George Clifford Varner (Ph.d. Thesis) 1967 121 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-2076

The subject investigation is concerned with the reduction of high-order nonlinear systems to second-order nonlinear systems so that the transient response can be obtained by phase-plane techniques. The reduction is performed by removing the nonlinear element from the high-order nonlinear system, then reducing the resulting high-order linear system to a second-order linear system. The second-order linear system is obtained by minimizing the integral of the square of the difference between the transient response of the high-order linear system and that of the second-order linear system. The nonlinear element is then inserted into the second-order linear system producing the second-order nonlinear system. Dissert. Abstr.

N69-10120*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
A DISCRETE-TIME DIFFERENTIAL DYNAMIC PROGRAMMING ALGORITHM WITH APPLICATION TO OPTIMAL ORBIT TRANSFER
Stanley B. Gershwin and David H. Jacobson Aug. 1968 64 p refs
(Grant NGR-22-007-068; Contract N00014-67-A-0298-0006) (NASA-CR-97475; TR-566) Avail: CFSTI CSCL 09C

Recently, the notion of Differential Dynamic Programming has been used to obtain new second order algorithms for solving nonlinear optimal control problems. Unlike concentional Dynamic Programming, the Principle of Optimality is applied in the neighborhood of a nominal, nonoptimal, trajectory. A novel feature of these algorithms is that they permit strong variations in the system trajectory. In this paper, Differential Dynamic Programming is used to develop a second order algorithm for solving discrete time dynamic optimization problems with terminal constraints. This algorithm also utilizes strong variations and, as a result, has certain advantages over existing discrete time methods. A nonlinear computed example is presented, and comparisons are made with the results of other researchers who have solved this problem. Author

N69-10142 Illinois Univ., Urbana.
REACTION WHEEL ATTITUDE CONTROL SYSTEM WITH MINIMUM ELECTRICAL ENERGY AND FIXED TIME CONSTRAINTS
Gerald Ellsworth Bergmann (Ph.D. Thesis) 1967 99 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-1710

A one-degree of freedom reaction wheel attitude control system for a space vehicle is analyzed. Optimal and sub-optimal control laws are determined which will force the system from an initial phase state to the origin within an arbitrarily selected response time. The control laws are optimal in the sense of minimum electrical energy required to accomplish the transition. The reaction wheel is assumed to be the rotor of an armature controlled d-c servomotor whose control voltage is limited by saturation. The control function is defined such that it is bounded with an algebraic minimum and maximum of -1 and $+1$, respectively. The control laws presented are of an open-loop type and as such cannot compensate for disturbances. A recycling technique is proposed which allows the control system to periodically adjust for sensor errors, external disturbances and system noise. Dissert. Abstr.

N69-10177 Illinois Univ., Urbana.
CLASSIFICATION AND ENUMERATION OF AUTONOMOUS SEQUENTIAL MACHINES
Hollis Franklin Ryan (Ph.D. Thesis) 1967 136 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-1844

A study has been made of the structure of the state transition graphs of autonomous sequential machines. The structural properties of the graphs are formally described and it is proved that a state transition graph of an autonomous sequential machine has a unique partitioning into components, that a component has a canonical partition into functional rooted trees, and that a functional rooted tree can be decomposed into a forest of functional rooted trees. Using the structural properties of the state transition graphs, nested classification systems are defined for the set of autonomous sequential machines having labeled states and for the set of autonomous sequential machines having unlabeled states. All the enumeration problems associated with the classification systems have been solved. In particular the number of connected labeled machines and the number of connected unlabeled machines have been found. In solving these enumeration problems solutions have also been found for several counting problems of more general application. Recursive formulas have been found for counting both labeled and unlabeled rooted trees. The problem of finding the number of cyclic permutations with non-distinct elements has been solved and a formula for calculating the coefficients of the Bell polynomials has been obtained. Numerical results are presented for autonomous sequential machines having from one to five states. Dissert. Abstr.

N69-10245 Wisconsin Univ., Madison.
TRANSIENT RESPONSE ANALYSIS OF A CLASS OF CONTINUOUS NONLINEAR TIME-VARYING AUTOMATIC CONTROL SYSTEMS BY FUNCTIONAL TECHNIQUES AND MULTIDIMENSIONAL LAPLACE TRANSFORMS
Richard Vincent Ridings (Ph.D. Thesis) 1967 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-12468

A new technique is presented in this thesis for determination of the approximate transient responses on nonlinear time-varying automatic control systems entailing analytic nonlinearities and continuous time-varying parameters. Application of the technique to a particular system entails (1) obtaining a functional characterizing equation for the system wherein the response appears implicitly; (2) recasting the functional equation in multidimensional Laplace transform notation; (3) solving the multidimensional Laplace transform equation, by use of the method of successive

approximations, for a multidimensional Laplace transform representation of the approximate response; (4) inverting the multidimensional transform representation of the response to obtain the approximate time response. Dissert. Abstr.

N69-10246 Wisconsin Univ., Madison.
AN ANALYSIS OF TRANSMISSION LINES ON THE SAME RIGHT-OF-WAY USING A DIGITALLY SIMULATED HYBRID COMPUTER
Sudhir Virmani (Ph.D. Thesis) 1967 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-12487

The representative system chosen for analysis consists of a transposed three phase a.c. line on the same right-of-way as a two conductor d.c. line. A digitally simulated hybrid computer is used to determine the transient voltages following certain system disturbances. The common right-of-way system is converted, by suitable transformations, to one which has five uncoupled modes of propagation. This is similar to the procedure used for isolated three phase lines for which, the positive, negative and zero sequence transformations give the corresponding isolated modes of propagation. These approximations neglect the distortion terms and become increasingly inaccurate for large time intervals and longer line lengths. Since the transmission lines studied were 400 miles long, an improved computer representation is developed which will give improved results for a period of about 100 milliseconds after the onset of the system disturbance. Dissert. Abstr.

N69-10281 Michigan Univ., Ann Arbor.
APPLICATION OF PICARD'S AND NEWTON'S METHODS TO THE SOLUTION OF TWO-POINT BOUNDARY-VALUE PROBLEMS IN OPTIMAL CONTROL THEORY
Joannus Leonardus de Jong (Ph.D. Thesis) 1967 263 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 67-17746

Convergence criteria are derived for applying Picard's and Newton's methods to the solution of two-point boundary value problems (TPBVP), and the practical aspects of the application of Picard's method are explored. Results from functional analysis on the convergence of iterative methods are translated and applied to the TPBVP. Methods of contraction mapping are reviewed, along with a modification of this method and Newton's method as they pertain to the operator equation. Also presented are the results of some numerical experiments involving two sample problems: (1) a minimum-time Earth–Mars orbital transfer with constant low thrust, which is solved by Newton's method, and a mixture of Newton's method and a modified Newton's method; and (2) a minimum-fule Earth–Mars orbital transfer with variable low thrust, which is treated as an almost linear problem and solved by Picard's method. Dissert. Abstr.

N69-10407# LTV Electrosystems, Inc., Greenville, Tex.
SYSTEM SIMULATION USING THE FAST FOURIER TRANSFORMATION
Nov. 1968 14 p refs
(G3685-29-038) Avail: Issuing Activity

The Fast Fourier Transform (FFT) is a computing algorithm, which, because of its efficiency, makes practical new avenues of investigation in the area of digital simulation. The techniques of application of the FFT in analysis of systems are described. The requirements for the sampling of signal waveforms and transfer functions representing equipment performance are discussed; attention is given to the criteria for selection of an appropriate sampling period. An example simulation of a typical radar receiver problem is illustrated in detail. Author

N69-10658# Joint Publications Research Service, Washington, D.C.
ADAPTIVE SYSTEMS
V. A. Trapeznikov et al 4 Nov. 1968 30 p refs Transl. into ENGLISH from the book "Tekhnicheskaya Kibernetika v SSR" Moscow, 1968 p 132–158
(JPRS-46793) Avail: CFSTI

Technical and economic requirements are used to classify adaptive automatic systems for complex control problems. Discussed are: (1) extremal control systems with some optimal index which is a function of one or more generalized coordinates of the target; (2) pattern recognition projects with training algorithms and machine fixation on a set of classes of objects; and (3) searchless self-adjusting systems with an adaptation rate commensurate with the transient process rate in the basic circuit. G.G.

N69-10667 Arizona Univ., Tucson.
THE ANALYSIS OF INTERCONNECTIONS OF SEQUENTIAL MACHINES BY POLYNOMIAL FUNCTIONS
Bobby Ray Hunt (Ph.D. Thesis) 1967 158 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-784

The algebraic structure of a finite state system is classically defined as a quintuple. A new representation of this algebraic structure is introduced. This representation, called the real number representation, is based upon the use of finite sets of real numbers for the state, input, and output sets of a finite state system and the description of the state-transition and output functions by polynomial functions. Multiple input systems are similarly defined. The interconnection of a set of finite state systems is formally defined and this definition is utilized to formally define the structure of the system which results from the interconnection of a set of finite state systems, called the resultant. Using the polynomial functions, a scheme is demonstrated to derive the real number representation of the resultant of an interconnection of finite state systems given the real number representations of each system in the interconnection. Dissert. Abstr.

N69-10755*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANALYSIS OF COMMUTATED NETWORKS EMPLOYING FEEDBACK CIRCUITS
Michael T. Borelli Washington Nov. 1968 93 p refs
(NASA-TN-D-4893) Avail: CFSTI CSCL 09E

The development of advanced automatic control systems often requires new and unusual circuits, components, techniques, and other such items, to provide the necessary control to accomplish a specific mission. An adaptive automatic flight control system for large space booster vehicles has been developed that uses tracking-notch filters composed of commutated networks (CN's). From this successful application and others cited in the literature, it appears that these networks are particularly well suited for use in tracking filters. In this investigation of CN's and in most practical cases, the reactive elements are capacitors. The commutation action in a resistor–capacitor CN can transform the frequency response characteristics of a low pass filter into that of a highly selective band pass filter. Effective low-frequency band pass or band elimination filters can be realized without the use of magnetic elements. These and other transformations of a network's basic characteristics provide very interesting properties that are useful for some special applications. The methods of analysis are those employing full-wave balanced commutation and include: (1) classical method; (2) difference equations; (3) modulation equivalents; and (4) Laplace transforms. Author

N69-10856*# Aztec School of Languages, Inc., Acton, Mass.
CRITICAL ANALYSIS OF DATA CHANNELS WITH INFORMATION FEEDBACK [KRITISCHE BEWERTUNG VON DATEN BERTRAGUNGSKANALEN MIT INFORMATION-SRUCKKOPPLUNG]

D. Schaffar Washington NASA Oct. 1968 21 p refs Transl. into ENGLISH of German Rept. No. BMWF-FFB-W-68-21
(Contract NASw-1692)
(NASA-TT-F-11937) Avail: CFSTI CSCL 09D

The capacity of a data channel with information feedback is compared to the capacity of a similar channel without information feedback. It is proven that it is not possible to increase the channel capacity by the introduction of information feedback. The reasoning behind the study is critically analyzed. In an annex the basic principles of information theory are summarized. Author

N69-10994# Sandia Corp., Albuquerque, N. Mex.
ANNOTATED LISTING OF A COMPUTER PROGRAM FOR SYNTHESIS OF MULTIPLE-OUTPUT ALL NAND COMBINATIONAL-LOGIC CIRCUITS
L. W. Maschoff Jul. 1968 19 p
(Contract AT(29-1)-789)
(SC-DR-67-693-A) Avail: CFSTI

An annotated main program and all subroutines required to evaluate the heuristic presented in SC-DR-67-693 and to synthesize combinational-logic circuits are presented. Author (NSA)

N69-10995# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
OPTIMAL FEEDBACK CONTROL OF THE RADIOACTIVE VOLTAGE STANDARD
David William Braudaway (Ph.D. Thesis) Mar. 1968 147 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SC-CR-68-3625) Avail: CFSTI

A two-limb calorimeter is used to produce a reference voltage. Heat flow in each limb produces a temperature rise across the limb air gaps. In one limb, the temperature rise caused by the radioactive source is sampled by a pair of temperature sensitive resistors. In the other limb, a second pair of resistors samples the temperature rise caused by the resistive heater. These four temperature sensing resistors are connected to form a bridge which is balanced when the heat outputs of the sources are matched. While the bridge ouptut is a measure of system response and power balance, the output voltage is produced by a sampling resistor connected in series with the heater. Because the thermal time constants of the system are long, automatic control of the balanced condition is desired. A mathematical model of the system behavior is given. Analysis of the bridge characteristics and the limb thermal behavior leads to linear-approximation models for each of these subsystems. The characteristics of a galvanometer-amplifier are also discussed. Author (NSA)

N69-11004#
METER OF THE MEAN INTERVAL BETWEEN PULSES
A. A. Bragin et al [1968] 4 p refs Transl. into ENGLISH from Metody Otbora i Preobraz. Inform. (Kiev), 1967 p 126-130
Avail: CFSTI

In relation to investigating pulse flows in queueing and nuclear physics communication systems, equations are derived for determining the mean interval for such events as the time of pulse appearance, and the mean duration or expectation time of the pause between pulses. The pulse duration ($\theta'-\theta''$) and the pause (θ'') is distributed according to some probabilistic law. A figure is included depicting such a pulse flow. The values of θ', θ'', or $\theta'-\theta''$ can be determined by using a comparatively simple circuit with capacitive storage under the single condition that the pulse duration should not be less than some finite quantity $\theta'-\theta''\tau_0$. It is shown that the statistical measurement error is independent of the magnitude of the measured interval, and remains unchanged throughout the whole measurement range. This is associated with the fact that the time constant of integration changes correspondingly with the change in the mean statistical interval. Author

N69-11015#
UNIVERSAL MULTICHANNEL COMMUTATOR CIRCUIT
Ia. E. Belen'kii [1968] 4 p refs Transl. into ENGLISH from Metody Otbora i Preobraz. Inform. (Kiev), 1967 p 120-125
Avail: CFSTI

The construction of complex automation systems in which information from a large number of sources is converted, imposes universality demands on the elements in such a system. The possibility of operating in both the cyclic, and in the step modes, as well as the start-stop, is demanded of systems with large number of channels from the same commutator. In emergency modes it is sometimes necessary to change the bypass direction in a commutator, i.e., to reverse. In these cases, the commutator should be universal, and operate in the step, cyclic, and start-stop modes in either direction. To construct the most universal commutator circuit, which would include the properties of a self-oscillating and slave multivibrator, as well as a forward and back trigger, a multi-phase trigger-multivibrator circuit was developed which retunes the operating modes by shunting part of the common emitter resistor of one of a series of triodes which are of auxiliary nature. Author

N69-11053# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE LOCK-IN RANGE OF AN AUTOMATIC PHASE CONTROL SYSTEM WITH NONLINEAR REACTANCE-TUBE CHARACTERISTIC
C. Chiang 10 Jan. 1968 25 p refs Transl. into ENGLISH from Tien Tzu Hsueh Pao (Peking), no. 3, 1965, p 244-253
(AD-675430; FTD-HT-23-619-67) Avail: CFSTI CSCL 9/5

This paper investigates a method for calculating the lock-in range of an automatic phase control system, in which the characteristic of the reactance tube is nonlinear. Some conclusions have been obtained and the validity of these theoretical conclusions have been confirmed by experiments. Author (TAB)

N69-11081# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTIMIZATION OF THE AUTOMATIC SEARCH PROCESS UNDER THE EFFECT OF RANDOM PERTURBATIONS [OPTIMIZATSIYA PROTESSA AVTOMATICHESKOGO POISKA PRI VOZDEYSTVII SLUCHAYNYKH VOZMUSHCHENIY]
N. Ye. Madzharov 6 Nov. 1967 18 p refs Transl. into ENGLISH from Tr. Energ. Inst. (Moscow), no. 50, 1963 p 125-134
(AD-675275; FTD-HT-23-875-67) Avail: CFSTI CSCL 12/1

It is pointed out that a random noise at the measuring-element input of an extremal system increases the time of extremum search. The probability of a false searching step can be reduced by a statistical averaging of several controlled-hunting steps, which makes these steps longer and, therefore, increases the total search time. It is noted that the Wald method of statistical sequential analysis is the optimum method with respect to the acceptable number of hunting steps consistent with a sufficiently short search time. This method investigates the random process by observing it and by setting up hypotheses about the nature of the process (for example, choosing between two solutions of two alternative situations). The method is peculiar in that it involves (a) a multistage statistical experiment and (b) the decision to desist or continue the experiment depending on a random previous step. TAB

N69-11095# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DECODING OF CYCLICAL CODES WITH CORRECTION OF DUAL ERRORS [O DEKODIROVANII TSIKLICHESKIKH KODOV S ISPRAVLENIYEM DVOYNYKH OSHIBOK]

V. D. Kolesnik et al 23 Oct. 1967 17 p refs Transl. into ENGLISH from the book "Problemy Peredaci Informatsii" Moscow, Izd. AN SSSR, 1965 p 86-96
(AD-675249; FTD-HT-23-780-67) Avail: CFSTI CSCL 9/4

The practical use of correcting codes hinges on the design of sufficiently simple setups capable of realizing the correction potentialities of such codes. The present article establishes decoding systems for cyclic codes correcting double independent errors. The entire decoding device is built from shifting registers with feedbacks. For a code length n, the size of the device grows as log/n to the base 2. This feature distinguishes this particular algorithm from other decoding methods in which the instrument size increases at least proportionally to n and sometimes even faster. A general description of cyclic codes with the correction of double independent errors is followed by a detailed presentation of the appropriate decoding algorithm, and the description of the shifting registers with feedbacks. The paper concludes with a discussion of various decoding devices and an illustrative example of a fifteen-term sample transmission by code capable of correcting double and discovering triple independent errors. TAB

N69-11156# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON ONE CLASS OF AUTOMATIC CONTROL SYSTEMS INVARIANT UNDER PARAMETER VARIATIONS
A. I. Kukhtenko and A. G. Shevelev 4 Dec. 1967 14 p refs Transl. into ENGLISH from Akad. Nauk Ukr. SSR, Slozhnyye Sistemy Upr. (Kiev), 1965 p 98-112
(AD-675239; FTD-HT-23-883-67) Avail: CFSTI CSCL 12/1

The problem of designing a dynamic system which would be insensitive to variation of its parameters is analyzed. It is indicated that although self-adapting systems in which the dynamic properties of the system remain unchanged with variation of its parameters are this kind of systems, theoretical studies and design of such systems are highly complex problems. Therefore, the author raises the question of whether it is possible to construct systems which have the characteristics of self-adaptive systems and are free of their shortcomings. The possibility of designing such systems is analyzed by using the methods of sensitivity theory and the methods of invariance theory. On the basis of the derived sensitivity equations and using invariance criteria, it is shown that in certain cases it is possible to design a dynamic system which is insensitive to variations of its parameters. The possibility of designing such invariant systems is illustrated by two examples: (1) the system is described by a system of four equations whose two coefficients a2(t) and k2(t) are considered as arbitrarily varying functions within certain given bounds; (2) an airplane autopilot system. TAB

N69-11175# RAND Corp., Santa Monica, Calif.
INITIAL VALUE METHODS IN OPTIMAL CONTROL THEORY
R. Kalaba and R. Sridhar Sep. 1968 20 p refs
(Contract F44620-67-C-0045)
(AD-675160; RM-5754-PR) Avail: CFSTI CSCL 12/1

A new approach to constrained variational problems is presented in which the variational problem is converted directly into a Cauchy problem, with no use made of Euler equations or dynamic programming techniques. Frequently the initial-value problem is stable, in contrast to the numerically unstable boundary-value problem for the Euler equations. Results are applicable in guidance and control studies and in those branches of mathematical physics described by variational principles. Author (TAB)

N69-11298 Joint Publications Research Service, Washington, D. C.
OPTIMIZATION OF ELECTRICAL SYSTEM POWER FLOW USING GRADIENT METHOD
A. Z. Gamm et al 19 Nov. 1968 25 p refs Transl. into ENGLISH from Electrichestvo (Moscow), no. 1, 1967 p 21-29
(JPRS-46898) Avail: SOD/CFSTI

The gradient method for optimizing the parameters characterizing the stationary conditions of a complex electrical system is detailed. Basic mathematical premises of the method are presented, and the calculation procedure for separating the gradient into subsystems is shown; and this is followed by details of both the algorithm and the program for computerizing the problem. Simplified optimization diagrams are included. M.W.R.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N69-10230*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SOLAR SIMULATOR OPTIMIZATION THROUGH DEFOCUSING: A RESULT OF COMPUTERIZED OPTICAL SYSTEM RAY-TRACING STUDY
H. N. Riise 15 Sep. 1968 22 p
(Contract NAS7-100)
(NASA-CR-97490; JPL-TR-33-384) Avail: CFSTI CSCL 14B

Collimation and uniformity in the simulated solar beam are the main objects of interest in this analysis. With the simple computer program used, the effect of varying certain parameters—the height of the mixer, the radius of the mixer, and the height of the test plane—could be determined easily. It was found that a theoretical uniformity could be improved from 5.28 to 5.01% and collimation could be improved from 1.6 to 1.078 deg by defocusing the optical system. The findings were used to locate the mixer most advantageously during its installation in the JPL 25-ft space simulator solar system. Author

N69-10248# National Research Council of Canada, Ottawa (Ontario).
PRODUCTION AND DISCHARGE OF TOXIC AND RADIOACTIVE GASES IN 'LINAC' TUNNEL IN FRASCATI [PRODUZIONE E SCARICO DI GAS TOSSICI E RADIOATTIVI NEL TUNNEL DEL LINAC DI FRASCATI]
M. Ladu, M. Pellicioni, and M. Roccella 1968 16 p refs Transl. into ENGLISH from the Italian report LNF-65/21, Nota Interna no. 282, 28 Jun. 1965, 12 p
(NRC-TT-1332) Avail: CFSTI

Calculations were performed to determine the production of toxic gases (NO_2 and O_3) and radionuclides (O^{15}, N^{13}, Cl^{38}, and C^{11}) in a high power linear accelerator tunnel. For simplicity it was assumed that the tunnel is a prism of square cross section 3 m on a side and 60 m long. The contributions of electrons and γ-rays to the production of toxic products were estimated separately, both with and without converters. The production of harmful molecules was calculated to be no greater than $A \times 10^{18}$ mol/sec, and the maximum admissible concentration is reached in approximately 20 min. To reduce noxious gases below admissible levels, the tunnel air should be ventilated at a rate of $Q \approx 60$ m^3/min. The same ventilation creates safe conditions for the effect of any dose for which the nuclides might be responsible. B.P.

N69-10264 European Organization for Nuclear Research, Geneva (Switzerland).
WIRE STRETCHING MACHINE FOR SPARK CHAMBERS
H. Alleyn, J. J. Guezennec, and G. Muratori 17 Sep. 1968 14 p
(CERN-68-34) Avail: Issuing Activity

A wire stretching machine was constructed; it consisted of a tubular beam with chariot, driving mechanism, two advance escapements, and a servo-mechanism to keep wire to be stretched under constant tension. Detailed descriptions and drawings are included for each of these components. The machine was capable of stretching wires of 0.03 to 0.2 mm in diameter, under tensions ranging between 20 and 500 grams. The average travelling speed along the stroke was about 0.5 m/sec. The wires most commonly used were beryllium–copper and phosphor–bronze. B.P.

N69-10266*# National Aeronautics and Space Administration, Washington, D. C.
LANGLEY RESEARCH CENTER, HAMPTON, VIRGINIA
1968 4 p
(NASA Facts 0-7/3-68) Avail: SOD; CFSTI CSCL 14B

An historical sketch is presented of the senior field establishment of the National Aeronautics and Space Administration. Highlights in research contributions since the Center's establishment are noted including the first Langley wind tunnel, first supersonic flight in 1947, and current investigations in hypersonic flight and propulsion systems. The Langley Research Center's contributions to Projects Mercury, Gemini, and Apollo are noted. D.H.B.

N69-10267# California Univ., Berkeley. Lawrence Radiation Lab.
STUDY OF THE REGENERATIVE EXTRACTOR OF THE BERKELEY 184-INCH SYNCHROCYCLOTRON
Arthur C. Paul 24 Apr. 1968 58 p refs
(Contract W-7405-ENG-48)
(UCRL-18211) Avail: CFSTI

The behavior of the regenerative extractor of the Berkeley 184-inch cyclotron has been studied by separating the properties of the incident beam from the properties of the regenerator. This was accomplished by considering the extraction efficiency as the product of two quantities, the differential extraction efficiency determined by the magnetic field perturbations, and the phase space density determined by the quality of the beam incident upon the regenerator. The calculations are based on the study of some 1500 particles representing a sampling over energy (radial amplitude), radial betatron phase (azimuth of maximum radial amplitude), vertical betatron amplitude, and vertical betatron phase. The particles are started inside the stable region of the radial betatron phase space and accelerated through at least one complete precessional oscillation (40–100 revolutions) before gaining sufficient energy to cross the separatrix of the phase space diagram and begin regeneration. The calculated extraction efficiency of 9% compares favorably with present machine operation. Author (NSA)

N69-10304*# National Aeronautics and Space Administration, Washington, D. C.
LEWIS RESEARCH CENTER, CLEVELAND, OHIO
1968 4 p
(NASA Facts 0-8/10-67) Avail: SOD $0.15; CFSTI CSCL 14B

An overview is presented on the research in propulsion and electrical power generation which is being conducted by the Center to advance the technology of chemical, nuclear and electric rockets, air breathing engines, and space electric power systems. Also discussed is the Plum Brook 60-megawatt research reactor facility which is being used for numerous basic physics, materials, and components tests leading to the development of a nuclear rocket engine system. M.G.J.

N69-10615# California Univ., Berkeley. Lawrence Radiation Lab.
EVALUATING ULTRA VACUUM PUMPING AND OUTGASSING BY COUNTING IONS OR MEASURING ION CURRENTS
Norman Milleron May 1968 13 p refs Presented at the 1st Combined Symp. Del. Valley Sect. and Greater N. Y. Chapt.-Thin Film Div., Princeton, N. J., 16 May 1968
(Contract W-7405-ENG-48)
(UCRL-18213; CONF-680524-1) Avail: CFSTI

The environmental quality of vacuum is emphasized and the measurement of pump performance by means of the gas fluxes through the pump is discussed. The outgassing and backstreaming tester with a quadrupole analyzer and an in situ calibration procedure are described. Six commercial pumps (Welch turbo-molecular, LN-trapped D. P., RCA sputter-ion Ultek sputter-ion, Varian sputter-ion, and N.R.C. Orbitron-type) were given preliminary tests, and the pumpdown performances are discussed. NSA

N69-10672*# Catalytic Construction Co., Philadelphia, Pa. Field Support Section.
LIQUID OXYGEN SYSTEM, LAUNCH COMPLEX 39, LAUNCH AREA B Test Report, 14 Sep. 1967–18 Jan. 1968
15 Mar. 1968 343 p Supported by NASA
(NASA-CR-97804; KSC-TR-460) Avail: CFSTI CSCL 22D

This report presents a summary of the functional test of the liquid oxygen system at Launch Complex 39, Launch Area B. The test was conducted from 14 September 1967 through 18 January 1968 in accordance with GP-278, Functional Test Plan, Liquid Oxygen System, Launch Complex 39, Launch Area B. The results of those sections of the test performed demonstrated the capability of the components and that portion of the system to function within the limits established by NASA design criteria. Based on test results and data obtained, the liquid oxygen system was accepted by the procuring agency. Author

N69-10765# Argonne National Lab., Ill.
ADJUSTMENT OF ACCELERATION CONDITIONS AND BEAM PARAMETERS OF THE LINEAR ACCELERATOR I-2
V. A. Batalin et al Jul. 1968 17 p Transl. into ENGLISH from Russian Rept. ITEF-513, 1967
(ANL-TRANS-653) Avail: CFSTI

A linear strong-focusing proton accelerator was put in action in the Institute for Theoretical and Experimental Physics. A 24.6-MeV proton beam with a pulsed current up to 130 ma was obtained. The methods of starting, the operations used for the beam intensity increase as well as the characteristics of the beam and the conditions of linac are given, and the instruments used for the beam measurements are described. Author (NSA)

N69-10766# Argonne National Lab., Ill.
CORRECTION OF THE AZIMUTHAL GRADIENT ERRORS IN A STRONG FOCUSING SYNCHROTRON
V. I. Balbekov et al Jul. 1967 5 p refs Transl. into ENGLISH from Russian Rept. IFVE-SKU-67-65K, 1967
(ANL-TRANS-647) Avail: CFSTI

Some features of the gradient correction in a strong focusing synchrotron are investigated. The system for independent correction of the radial and vertical gradient stop-bands is described. Author (NSA)

N69-10798# Stanford Univ., Calif. Linear Accelerator Center.
TWO-MILE ACCELERATOR PROJECT Quarterly Status Report, 1 Jan.–31 Mar. 1968
Jul. 1968 49 p
(Contracts AT(04-3)-400; AT(04-3)-515)
(SLAC-89; QSR-23; QSR-17) Avail: CFSTI

The developments and operation of the Stanford Linear Accelerator during January 1, 1968 to March 31, 1968 are

discussed. A summary of accelerator operations include the following: operating hours, beam intensity, klystron experience, bubble chambers, data analysis, computer operations, and special operating features such as positrons, rf separator, 82-inch bubble chamber, beam knockout, power supplies, and scheduled shutdowns. Other topics discussed were accelerator developments, research area developments, research division developments, accelerator engineering, klystron studies, and plant engineering. NSA

N69-10866*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SYNCHROTRON RADIATION FROM ELECTRONS IN HELICAL ORBITS
Kunitomo Sakurai Aug. 1968 11 p refs
(NASA-TM-X-63381; X-615-68-334) Avail: CFSTI CSCL 20G

This paper considers correction factors of some of the commonly used results of synchrotron radiation theory both in vacuo and in ambient plasmas. These revisions are important when the spectral distribution of synchrotron radiation and the wave frequency range in which the influence of ambient plasmas becomes serious are considered. Author

N69-10888*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
BLAST SHIELDS TESTING
Walter V. Medenica Washington Nov. 1968 68 p refs
(NASA-TN-D-4894) Avail: CFSTI CSCL 20K

Several types of protective steel shields were exposed to explosive blasts of RP-1 and liquid oxygen (LOX) or liquid hydrogen (LH_2) and LOX combinations, as a ride-along project of the Pyro Project. They included: solid arched plates, angle deflectors, wire screen No. 1 (65.3% open area), wire screen No. 2 (48% open area), solid flat plates, and wire screen No. 3 (27% open area). The first four of the above shields were instrumented with strain gauges and pressure transducers. Author

N69-10922# Library of Congress, Washington, D. C. Aerospace Technology Div.
THE 2-BeV LINEAR ELECTRON ACCELERATOR AT THE KHAR'KOV PHYSICOTECHNICAL INSTITUTE
Andrey Polushkin *In its* Foreign Sci. Bull., Vol. 4, No. 10 Oct. 1968 p 15-25 refs (See N69-10920 01-34)
Avail: CFSTI

Parameters, operating principles, maintenance, building and out-building layout for the 2-Bev linear accelerator which has been in operation since 1966; are described. The injection, accelerating, rf pulse supply, vacuum and focusing systems are discussed. In addition, the accelerator control and the output beam shaping system are examined, and the characteristics of the accelerated beam are given. Author

N69-10984# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
MEASUREMENT OF THE DYNAMIC FREQUENCY-AMPLITUDE CHARACTERISTIC OF THE SYNCHROCYCLOTRON
I. B. Enchevich and T. N. Tomilina 1968 22 p refs In RUSSIAN
(JINR-P9-3970) Avail: CFSTI

The results are given of the measurements of the dynamical frequency–amplitude characteristic of the 680 MeV synchrocyclotron high-frequency system depending on the time. The technique described gives the possibility to control the dynamical characteristic and to fix it quickly, with the accuracy sufficient for practical aims (in the frequency ±0.025%, in the amplitude of the accelerating voltage ±8.5% and in the time intervals ±0.06%). Besides, this technique allows to obtain a number of characteristics such as: the frequency of the ion capture into the process of acceleration, the frequency of the proton extraction. It became possible to determine the effect of the beam loading on the resonance system and to obtain some data for determination of the amplitudes of the betatron and radial-phase vibrations, which, at all, cannot be measured in static regime. Author (NSA)

N69-11029# California Univ., Berkeley. Lawrence Radiation Lab.
SUPERCONDUCTING MAGNETS FOR THE 200-GEV ACCELERATOR EXPERIMENTAL AREAS
Robert B. Meuser Jul. 1968 9 p refs
(Contract W-7405-eng-48)
(UCRL-18382) Avail: CFSTI

The decision whether to use conventional or superconducting magnets for beam transport in the first of the 200-GeV accelerator experimental areas must be made by late 1969. The practicability and economics of the superconducting magnet system to aid in making that decision is studied. A major part of the program is to build a beam line containing several superconducting bending and quadrupole magnets. Magnet requirements, magnet design and material selection, and the refrigeration system design are discussed. Author (NSA)

N69-11035# Joint Inst. for Nuclear Research, Dubna (USSR).
ISOCHRONOUS CYCLOTRON FOR PRODUCTION OF CHARGED PARTICLE BEAMS OF A HIGH DEGREE OF MONOENERGY (M. C.)
A. A. Glazov, Yu. N. Denisov, V. P. Dzhelepov, V. P. Dmitrievskii, B. I. Zamolodchikov et al 1968 42 p refs In RUSSIAN
(JINR-P9-3932) Avail: CFSTI

The physical investigations are reviewed, which were carried out using the monoenergetic beams p, d, ^{3}He, ^{4}He, ^{6}Li at a maximum proton energy 60 MeV and the intensity being 100 μA. A variant of the isochronous sector cyclotron with a small spread (10^{-4}) in the accelerated particle beam, has been considered. Continuous variation of the particle energy in the ratio 1:4 is also possible. A tentative scheme of the extracted beams lay-out and further analysis in energy is given. Author (NSA)

N69-11048# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Servizio Documentazione.
PROBLEMS OF SHIELDING CONNECTED WITH THE LINEARIZATION OF INTENSITY OF THE FRASCATI ELECTROSYNCHROTON [PROBLEMI DI SCHERMATURE CONNESSI CON L'INNALZAMENTO D'INTENSITA DELL'ELETTROSINCROTRONE DI FRASCATI]
M. Pelliccioni, P. Picchi, and G. Verri 19 Sep. 1968 11 p refs In ITALIAN *Its* Nota Interna No. 415
(LNF-68/55) Avail: CFSTI

Shielding problems resulting from the installation of a Van de Graaf accelerator, which will increase the intensity of the Frascati Syncrotron by a factor of ten are examined. The Monte Carlo method is used for the calculations. Primary nucleons, gamma attenuation, and various types of cement are considered. The calculations were programmed in FORTRAN 4 language for the IBM 7040 Computer. Tables and graphs summarizing results are included. Transl. by F.O.S.

N69-11076# United Kingdom Atomic Energy Authority, Harwell (England).
GRAPHITE RESISTANCE FURNACE FOR USE IN THE INERT GAS FUSION METHOD OF DETERMINING GASES IN SOLIDS
B. L. Taylor May 1968 8 p refs
(AERE-R-5763) Avail: CFSTI

A high-current-resistance furnace was designed for use in the inert gas fusion method of determining oxygen and nitrogen in materials. The heating element and heat shields are graphite. Particular attention was given to those features that are important when the furnace is used in controlled-atmosphere glove boxes. Author (NSA)

N69-11105# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aerospace Research Labs.
AERODYNAMICS OF THE HYPERSONIC SLIPPER BEARING
Robert H. Korkegi and Ronald A. Briggs Feb. 1968 83 p refs
(AD-675186; ARL-68-0028) Avail: CFSTI CSCL 14/2

With rocket-boosted sleds on test tracks accelerated to several thousand feet per second, their rail-guided supporting slippers are exposed to severe aerodynamic heating and friction. The slippers are usually wrapped around the rail for support in lateral directions with allowance for a small gap between the two. Air flowing through the gap is shock-compressed to high pressures and temperatures resulting in high heat rates to the inner surface of the slipper. Although the motion of sled and slipper is complex, as a first approximation the slipper flow is studied for a steady state configuration assuming locally two-dimensional flow as the gap height is small compared with lateral dimensions. The flow model consists of a laminar stagnation region at the leading edge of the slipper followed by separate turbulent boundary layers on slipper and rail (shock-tube type) eventually merging into a full shear layer which tends toward a Couette flow asymptote. Heat rates and pressure distributions along the gap are estimated for atmospheric conditions in the speed range from Mach number 4 to 10. It is found that heat rates on the inner surface of the slipper are of the same order as those at the stagnation point for practical leading edge radii, and these are as high as any encountered on actual re-entry vehicles. Furthermore, the configuration is found to be statically unstable causing the gap to collapse or widen when perturbed from equilibrium. Author (TAB)

N69-11133# Melpar, Inc., Falls Church, Va.
CONCEPT FORMULATION REPORT: SYNTHETIC FLIGHT TRAINER SYSTEM Final Report, Dec. 1967–Apr. 1968
Franklin E. Young and Eugene R. Hall Apr. 1968 513 p refs
(Contract N61339-68-C-0107)
(AD-675505; NAVTRADEVCEN-68-C-0107-1) Avail: CFSTI CSCL 1/3

The report covers research and investigation into the technical and economic feasibility and best technical approach for development of a synthetic flight training system. Required system characteristics are enumerated. Digital computers, trainee stations, instructors consoles, motion platforms and other system components are evaluated in the light of SFTS requirements. Techniques for automatic demonstration of training problems and a concept for idioadaptive training are described. An outcome of the study of components and techniques is a recommended system for development. Author (TAB)

N69-11141 Kling (Vincent G.) and Associates, Philadelphia, Pa.
WASHINGTON NATIONAL AIRPORT, MASTER PLAN Final Report
Washington FAA Oct. 1968 71 p
(Contract FA-66-WA-1559)
Avail: SOD $4.00

Four master plans are presented for modernizing Washington National Airport to meet 1980 requirements. Safety, convenience, economy, the characteristics of the existing airport, and the nature of traffic anticipated were the prime criteria considered in the development of these schemes. The plans are specific in regard to functional relationships and size, but are schematic in regard to architectural design. Detailed analyses are presented of air traffic and flight activity, redevelopment of the landing area, ground and building space requirements, and the terminal design considerations. The utility systems and economic feasibility for each plan are also assessed. B.P.

N69-11209# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
MULTILAYER SPARK CHAMBER FOR FISSION FRAGMENTS DETECTION
Yu. V. Ryabov and So Dhon Sik 1968 12 p refs In RUSSIAN
(JINR-P3-3957) Avail: CFSTI

A multilayer and multiwire spark chamber of a corona type with a plane cathode and the area of the fissioning layer being ≈ 2000 cm^2 has been developed and investigated. It is shown that the efficiency of the fission fragment detection can reach 60% at the detection efficiency of α-particles being $\approx$ 10%. The chamber is used for the time-of-flight measurements of the fission cross sections by the pulsed neutron spectrometer of the JINR. Author (NSA)

N69-11222# Nationaal Lucht-En Ruimtevaartlaboratorium, Amsterdam (Netherlands).
HOT JET SIMULATION FACILITY FOR NRL WIND TUNNELS
[1968] 12 p
Avail: Issuing Activity

A comprehensive description is given of NLR's operational system for simulating hot jets of aircraft and rocket models in its low speed, transonic and supersonic wind tunnels. Stagnation jet temperatures can be reached, ranging from 250 °C–980 °C, while the maximum attainable stagnation jet pressure is 60 kg/cm^2. Author

N69-11249# Academy of Sciences (USSR), Moscow.
TOROIDAL EFFECT ON THE MAGNETIC SURFACE OF STELLARATOR
I. S. Danilkin and I. K. Karpenko 1967 35 p refs In RUSSIAN
(NP-17561) Avail: CFSTI

Magnetic surfaces in a two-inlet stellarator were investigated, considering corrections for the system curvature K, and using methods previously developed by Mercier and others. Surfaces in the vicinity of the magnetic axis system, whose position depends on current distribution in the stellarator helical magnetic field, were determined by exact solutions for the magnetic field potential, previously developed by L. M. Kovrizhnykh. Data obtained described the system of magnetic surfaces in the preaxial area and the qualitative topological changes in the peripheral region (in the vicinity of the separatrix of the initial system with K = 0). Author (NSA)

N69-11253# Brookhaven National Lab., Upton, N. Y.
ACCELERATOR DESIGN USING CONSTANT GRADIENT SUPERCONDUCTING MAGNETS
E. B. Forsyth 10 Jul. 1968 21 p refs
(BNL-12690) Avail: CFSTI

The design of an accelerator which attempts to use the existing characteristics of superconducting magnets is presented. A 1-GeV accelerator using these principles turns out to be a weak-focusing fast-cycling synchrotron. As such it could be used as a relatively low cost meson factory, though the design is not sufficiently advanced for a cost analysis. Several problem areas have appeared, particularly low energy stability and ejection at final energy. It is clear that the simple gradient field proposed cannot be achieved in practice and, indeed, further analysis may indicate modifications which would lead to an improved accelerator. An example is the incorporation of alternating gradient ridges in the field to improve the focusing properties. However, the basic principle of a superconducting magnet reflecting field will remain the same. Author (NSA)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N69-10011 Connecticut Univ., Storrs.
INVESTIGATION OF A MOVING NORMAL SHOCK WAVE AT THE JUNCTION OF A RIGHT ANGLE BRANCH TO A STRAIGHT SHOCK TUBE
Wellen Gilbert Davison (Ph.D. Thesis) 1967 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-1333

In this investigation, the subsonic flow conditions at the junction of a right angle branch to a straight shock tube that results from the passage of a moving normal shock wave traveling into the undisturbed air of the straight shock tube were considered. The shock tube used in the experimental investigation had a 4 × 4 inch square cross section that was fitted with a right angle branch tube of the same cross-sectional area. At the junction of the shock tube and the right angle branch, the test area was either fitted with glass windows so that the flow field could be photographed using a Schlieren light system, or it was fitted with pressure transducers so that the pressure at various points within the junction area could be found. As the moving normal shock wave in the straight shock tube passes the opening of the branch tube at the junction, a two-dimensional flow field will result. Dissert. Abstr.

N69-10012 Colorado State Univ., Fort Collins.
A CYLINDER IN A TURBULENT SHEAR LAYER
Alan Thomas Roper (Ph.D. Thesis) 1967 215 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 68-2602

This dissertation describes by means of flow visualization, the qualitative behavior of the flow field about a circular cylinder situated in a turbulent shear flow. In certain instances the behavior is described analytically. Special attention in the flow visualization study is paid to the periodic shedding of the horseshoe vortex at the base of the cylinder. Two complementary methods are proposed for estimating pressure distributions on the cylinder and are compared to experimental data. Also considered are methods for describing some portions of the large scale eddy structure which forms about the cylinder. The problem of local scour at bridge piers is considered at length, and the prediction of maximum scour depth is related analytically to the Reynolds number based on pier width. This relation is justified by the use of experimental data. Arguments are presented which indicate that current methods of scour prediction imply a Reynolds number dependence similar to that uncovered in this study. Dissert. Abstr.

N69-10021 Colorado State Univ., Fort Collins.
PHYSICAL PROPERTIES OF POROUS MEDIUM AFFECTING LAMINAR AND TURBULENT FLOW OF WATER
Nazeer Ahmed (Ph.D. Thesis) 1967 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-2605

The influences of certain physical properties of the porous medium on the flow phenomena were studied. An equation, representing hydraulic gradient as a function of bulk velocity, was developed by analyzing the Navier-Stokes equations. During the development of the equation it was shown that energy losses caused by turbulence being small could be neglected in comparison to the energy represented by convective terms. Two dimensionless parameters were developed from the flow equation, and a unique relationship was shown to exist between them for all porous media studied in this investigation. The characteristic length of the flow was shown to have linear relationships with particle diameter obtained from sieve analysis, and pore and grain diameter obtained from cut-section data of porous media. Dissert. Abstr.

N69-10042 California Inst. of Tech., Pasadena.
LAMINAR FLOW OVER TRANSVERSE RECTANGULAR CAVITIES
Thomas Charles Reihman (Ph.D. Thesis) 1967 145 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-17072

An experimental investigation was conducted on the laminar flow of water over transverse rectangular cavities, ranging in size from 1/8 in. to 1 in. The flow over the cavities was observed for an ϵ^* range of from 16 to 400. The quantity ϵ^* may be regarded as a Reynolds number for the cavity. The desired flow approaching the cavities was obtained one foot from the leading edge of a flat plate suspended in an open surface water tunnel at free stream velocities from 0.125 to 0.75 ft/sec. Visual studies, instantaneous velocity measurements, and velocity profile determinations confirmed that the flow was laminar. The velocity measurements were obtained by means of a hot film anemometer. Dissert. Abstr.

N69-10070*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PREDICTION OF THERMODYNAMIC EFFECTS OF DEVELOPED CAVITATION BASED ON LIQUID-HYDROGEN AND FREON-114 DATA IN SCALED VENTURIS
Royce D. Moore and Robert S. Ruggeri Washington Nov. 1968 25 p refs
(NASA-TN-D-4899) Avail: CFSTI CSCL 20M

Cavity-pressure-depression measurements made in cavitated regions of hydrogen and Freon-114 (dichlorotetrafluoroethane) in two scaled venturis were used to evaluate experimental exponents of previously reported equations for the prediction of thermodynamic effects of cavitation for venturis. This prediction method accounts for changes in liquid, temperature, flow velocity, cavity length, and venturi scale. Use of the method requires similarity of body and cavity and a known cavity-pressure depression at one operating condition. The experimental data used included a velocity range of 20 to 205 feet per second (6.1 to 62.5 m/sec) and cavity lengths from 0.2 to 2.7 free stream diameters. Author

N69-10072 Alabama Univ., University.
HYPERSONIC FLOW OF AIR AROUND BLUNT BODIES WITH FINITE CHEMICAL REACTION RATE
Kenneth Orval Thompson (Ph.D. Thesis) 1967 152 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-1069

The necessary thermodynamic variables and source functions of a five component coupled reacting air model in the dissociation temperature regime are derived from statistical mechanics under the assumption of local thermodynamic equilibrium reactions is derived, solved numerically, and the results presented. The basic equations for reacting flow around axisymmetric and two-dimensional blunt bodies with finite chemical reaction rate are derived in general form. The resulting partial differential equations are transformed by the method of integral relations in its one-strip form to a system of ordinary differential equations, which are then numerically integrated. Results of the calculations for the stagnation line and forebody of two cases of a sphere and one case of a cylinder in the Mach number range M = 14.25 to M = 20 are presented, together with eight other cases of stagnation line flow. Dissert. Abstr.

N69-10080 State Univ. of Iowa, Iowa City.
NUMERICAL SOLUTION OF AN INTEGRAL EQUATION FOR FLOW FROM A CIRCULAR ORIFICE
Bruce Woodson Hunt (Ph.D. Thesis) 1967 53 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-944

Three internationally separate investigations since the year 1916 have treated specific cases of free-surface potential flow through an axially symmetric orifice. In the year 1956, however, the American mathematician, Garabedian, questioned the accuracy of these previous solutions. Hence, this study was initiated as an

attempt to either confirm or disprove the results of previous research on the problem. An integral equation resulting from a vorticity distribution over the boundary is used to solve numerically for the flow through an orifice. Free-surface profiles, contraction coefficients, and boundary pressure distributions are determined for four different ratios of orifice area to pipe area, and a comparison is made between the numerical and experimental results of both this study and previous studies. The final results of this study agree closely with the results of Garabedian's investigation. Dissert. Abstr.

N69-10081 Connecticut Univ., Storrs.
A STUDY OF FLOW PAST A SHIP-LIKE BODY
Raymond Stewart Hall, Jr. (Ph.D. Thesis) 1967 141 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-1352

A method is presented for calculating the flow about ship-like bodies in the presence of a linearized free surface and also for determining the interaction effect of potential flow and boundary layer on wave-making resistance. The complete velocity potential for a vertical line source and its image system is derived and the expressions for the velocity components obtained. A computer program was written to evaluate these components and the potential at any field point. Several numerical methods for predicting the value of oscillating integrals were evolved to greatly reduce computer calculation time. In the second part of the study a revised method is presented for the calculation of the three dimensional boundary layer characteristics in streamline coordinates, having the potential flow solution of the first part available. A computer program was written that traces the body streamlines and also calculates the boundary layer characteristics along them if desired. Dissert. Abstr.

N69-10110*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
APPLICATION OF THE CHARACTERISTIC METHOD IN CALCULATING THE TIME DEPENDENT ONE-DIMENSIONAL, COMPRESSIBLE FLOW IN A TUBE WIND TUNNEL
John D. Warmbrod and Heinz G. Struck 21 Aug. 1968 102 p
(NASA-TM-X-53769) Avail: CFSTI CSCL 20D

A method for calculating one dimensional, time dependent flow through a pressure tube wind tunnel is presented. The computational procedure involves the method of characteristics for the one dimensional unsteady flow of a perfect gas and accounts for area changes, shock formations, and intersection of discontinuities in the flow field. A computer program written in Fortran language was constructed for the CDC 3200 digital computer and is presented along with a detailed description of the preparation of input for the program. Calculated results of the program are presented for a pressure tube wind tunnel now under construction. Author

N69-10133*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
EULER–LAGRANGE RELATIONSHIP FOR RANDOM DISPERSIVE WAVES Scientific Report
D. P. Hoult 1 Apr. 1968 21 p refs
(Grant NsG-134-61; Contract AF 49(638)-1708)
(NASA-CR-97454; AD-673511; AFOSR-68-1597; SR-318)
Avail: CFSTI CSCL 20D

It is shown that the equations for the motion of a tagged fluid particle in a random wave field define a singular perturbation problem, characterized by a non-uniformity at large times. The uniformly valid asymptotic expansion to this problem, the Euler-Lagrange relationship for random dispersive waves, is obtained. As an application of these general results, an integral representation of the solution is worked out for the case of vertically propagating random acoustic waves in an isothermal atmosphere. It is shown that the non-uniformity of mediums leads to a wave generated diffusion process. The time and length scales over which the process is diffusive are determined, and a formula for the diffusion coefficient is presented. Author (TAB)

N69-10140 Princeton Univ., N. J.
PARAMETRIC PUMPING SEPARATION WITH SPECIAL ATTENTION TO GASEOUS MIXTURES
Murray Alexander Mc Andrew (Ph.D. Thesis) 1967 136 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-2501

Parametric pumping is a recently devised dynamic adsorption principle which provides a new basis for separating components of fluid mixtures. Periodic temperature variations induced in a bed of adsorbent cause similar concentration changes in the fluid exterior to the solid; interaction with an imposed alternating fluid displacement produces an axial concentration gradient in the column. In this thesis the relevance of this principle to gaseous mixtures was examined by computations and experiments. Computational studies revealed that although a positive thermodynamic basis was demonstrated herein to exist (viz., a temperature dependent adsorptive equilibrium of methane on fibrous carbon), significant separations are theoretically feasible only if the normally large disparity between volumetric heat capacities of solids and gases is offset by using a combination of these variables: high total pressure (> 10 atm.), low temperatures and small volumetric ratios of adsorbent-to-gas. Dissert. Abstr.

N69-10143 University of Southern Calif., Los Angeles
A STUDY OF THE KINETIC THEORY OF THE STEADY SPHERICAL SOURCE EXPANSION INTO A VACUUM
Tsu-yee Chen (Ph.D. Thesis) 1967 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-1675

The steady spherical source expansion into a vacuum is studied based on the moment equations of velocity distribution function, under the assumptions that the flow is hypersonic and near-equilibrium at an initial radius which is at finite distance from the origin. It represents a further development of the previous study by Edwards and Cheng, including a general study of the asymptotic theory for a Maxwellian gas or B-G-K model under a high Mach number M, and solutions to the leading and first order approximations. In addition, the effect of nonequilibrium in the initial condition is analyzed. Included also is a study of the asymptotic behavior of the B-G-K solution at upstream as well as far downstream and its dependence on the molecular force law. Finally, the effect of the departure from the Maxwellian force law on the collision integral is studied. Dissert. Abstr.

N69-10157 Virginia Polytechnic Inst., Blacksburg.
AXISYMMETRIC AND NON-AXISYMMETRIC MODES OF INSTABILITY FOR FLOW BETWEEN ROTATING CYLINDERS WITH A TRANSVERSE PRESSURE GRADIENT
Donald Clarence Raney (Ph.D. Thesis) 1967 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-2069

The stability of the flow of a Newtonian fluid between concentric cylinders is considered where the flow is also subjected to a transverse pressure gradient. The problem considered is thus a combination of the problem first considered by Taylor (1923) and Dean (1938) for pure rotation and pure pressure flow, respectively. The investigation is restricted to the case where the annulus between the cylinders is small and the numerical results are confined to the case where the outer cyclinder is stationary. Considered are the following three conditions: (1) assuming axisymmetric disturbances imposed on the original flow and a stationary marginal state; (2) assuming axisymmetric disturbances and an oscillatory marginal state; and (3) assuming non-axisymmetric disturbances and an oscillatory marginal state. The critical Taylor number (non-dimensional parameter characterizing the onset of instability for the problem) has been determined for a wide range of values of λ (both positive

and negative). The parameter λ is defined as the ratio of the average velocity of pumping to average velocity of rotation and thus defines the initial steady state velocity distribution. Numerous curves are shown relating the various system parameters at the onset of instability and the FORTRAN computer programs used in the numerical calculations have also been included. Dissert. Abstr.

N69-10174 State Univ. of Iowa, Iowa City.
SURFACE DIFFUSION IN KNUDSEN AND SLIP FLOW
Yeong Sun Kang (Ph.D. Thesis) 1967 60 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-947

The surface diffusion phenomenon was studied theoretically and experimentally. The theory consists of the derivations of a general equation which covers the whole temperature and pressure ranges of the diffusional flow of gases through porous media for monolayer adsorption, and of a working equation which has been developed by a classical approximation for the experimental data correlation. He, H_2, Ar, O_2, N_2 and CO_2 gases were used for the flow measurement through a porous ceramic disk with the maximum pore diameter of 0.3 micron. The experimental data were correlated by the working equation in the form of the permeability times the square root of the product of molecular weight and temperature. This quantity calculated from experimental data showed a minimum value but did not show a maximum in the range of 77 to 975°K with the system used in this investigation. Dissert. Abstr.

N69-10183 Alabama Univ., University.
AN ANALYTICAL AND EXPERIMENTAL STUDY OF THE MINIMUM PRESSURES IN CIRCULAR PIPE BENDS
Gerald Ray Guinn (Ph.D. Thesis) 1967 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-1043

One of the effects of a pipe bend located on the suction side of a turbopump is to induce premature cavitation in the pump by the convection of cavitation nuclii from the bend if it is cavitating itself. The minimum static pressure is the primary flow variable that governs the onset of cavitation, and it is the purpose of the present investigation to analytically and experimentally examine some of the feature of minimum pressure in circular pipe bends. An analysis of the flow in a bend at the station of minimum pressure was performed using the shedding layer approach. The flow was assumed to be potential in a central core with a viscous layer near the wall containing a boundary layer and a shedding layer. All derivatives in the axial direction were assumed to vanish and it was assumed that there was no flow normal to the plane of curvature. Comparison of the flow variables in the central core with limited experimental data indicated satisfactory agreement, the discrepancy being primarily due to the inability of the analysis to correctly predict the boundary layer thickness at the stagnation points. Since the minimum pressure is strongly influenced by the viscous flow at the inside stagnation point, the analytical predictions of minimum pressure were quite conservative in nature. The experimental investigation consisted of static pressure measurements at the walls of four-inch diameter circular pipe bends with five radii of curvature. The Reynolds number varied from 0.5×10^6 to 1.7×10^6. As predicted by the theory, the pressure coefficients were independent of Reynolds number, except for the bend with the smallest radius of curvature. For the two largest radius bends and the smallest radius bend, the minimum pressure occurred at a deflection angle of 22-1/2°; in the other bends it occurred at 30°. Potential flow considerations adequately predicted the minimum pressure coefficient for the largest radius bends. Dissert. Abstr.

N69-10217 Michigan Univ., Ann Arbor.
TWO-PHASE VORTEX FLOW
James Francis Lafferty (Ph.D. Thesis) 1967 172 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 67-17802

An analytical model is developed to describe gas-jet driven two-phase vortex flow. Utilizing experimental data, the model is used to calculate the velocity distributions of the two phases within an air-water vortex. The computed velocities are in very good agreement with independent measurements and with trends predicted from other investigations of single-phase vortex flow. The experimental investigation was conducted using an air-water vortex contained in a cylinder chamber 5.0 inches in diameter and 1.0 inch high. Data for pressure and void fraction distributions are presented as a function of pressure drop (2 to 30 psi) across the vortex and input air pressure (10 to 50 psig). The results of the velocity calculations indicate that approximately 70% of the input air-jet angular momentum is dissipated near the cylindrical wall of the vortex chamber. The liquid velocity is found to be approximately proportional to the square-root of the pressure drop across the vortex. Dissert. Abstr.

N69-10218 Illinois Univ., Urbana.
ON THE MOTION OF SMALL PARTICLES IN A TURBULENT FLUID FIELD
Mostafa Ayatollah-Zadeh Shirazi (Ph.D. Thesis) 1967 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-1855

An analytical and limited experimental investigation has been made for the statistical transport behavior of small particles in a turbulent flow field. Two types of nonlinearities associated with the particle response are recognized and referred to as *essential* and *statistical* nonlinearities. The former concerns the dependence of the fluid forcing function on the particle position and the latter ensues when there is statistical interaction between the forcing function and the particle response. The nonlinear Lagrangian equation of particle motion is then transformed using conditional averaging with the consequence that the said nonlinearities become separable. Under suitable restrictive conditions the *statistical* nonlinearity may be ignored and the stochastic integro-differential equation is then treated by the application of Fourier transform. Dissert. Abstr.

N69-10220 Alabama Univ., University.
STUDY OF PHASE CHANGE DYNAMICS BY A FREQUENCY RESPONSE TECHNIQUE
Argyrios J. Lygeros (Ph.D. Thesis) 1967 172 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-1050

The dynamics of condensation and evaporation of a pure liquid (Freon 12), initially in equilibrium with its own vapor, have been studied. Sinusoidal oscillations of the pressure of the vapor were used as driving force causing film-wise condensation on the walls of the container during the compression part of each cycle followed by re-evaporation of the film during the expansion part of the cycle. Variations of the thickness of the liquid film condensate were followed by measuring photoelectrically the intensity of monochromatic light transmitted through the film. A mathematical model for condensation and evaporation was developed considering interfacial resistance as the controlling resistance. According to this model, pressure instantaneously affects the rate of condensation or evaporation. Dissert. Abstr.

N69-10234 University of Southern Calif., Los Angeles.
EFFECT OF HIGH POLYMER ADDITIVES ON DIFFUSER SEPARATION FLOW NOISE
Ben Minoru Ishino (Ph.D. Thesis) 1967 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-1193

An exploratory investigation was undertaken with the main objective of obtaining experimental values, using bench-type apparatus, on the effect of high polymer additives in water on liquid

flow noise. A test system was designed and built. This system, with a variable angle two dimensional diffuser test section, is a low velocity blowdown tunnel suitable for handling polymer additives. Tests were made with polyethylene oxide, guar gum and tap water for different flow conditions. For all test measurements, the velocity at the diffuser throat section was uniformly distributed over most of its width. The results with tap water for parallel diffuser wall configuration showed fair agreement with the results of other investigators. As observed by others, remarkable reductions in pressure loss through the parallel wall diffuser were measured when small amounts of polymer were added to tap water. Dissert. Abstr.

N69-10254# Joint Publications Research Service, Washington, D. C.
BOUNDARY CONDITIONS IN THE THERMAL EFFUSION PROBLEM
G. A. Kokin and L. A. Udonova *In its* Collection of Articles on Instr. for Studying Upper Atmosphere 22 Oct. 1968 p 28–36 refs (See N69-10251 01-14)
Avail: CFSTI

The problem is discussed of selecting the boundary conditions for describing a flow of gas in a capillary at low pressures. The results are given on an experiment for determining the coefficient of thermal effusion of air in a glass capillary at a high temperature. Author

N69-10293*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
WATER FLOW AND CAVITATION IN CONVERGING-DIVERGING BOILER-INLET NOZZLE
James R. Stone and Nick J. Sekas Washington Nov. 1968 23 p refs
(NASA-TM-X-1689) Avail: CFSTI CSCL 20D

Experimental flow-pressure relations were determined for water flowing through a 0.025-inch throat diameter converging-diverging conical nozzle. The nozzle was tested with and without a plug and wire helix insert downstream of the throat. Such nozzles are being studied for possible use as inlets for single tube once through Rankine cycle boilers. The test nozzle is made of transparent plastic. Cavitating and noncavitating data are reported for throat velocities from 49 to 94 ft/sec and temperatures from 57° to 171° F. In well-developed cavitation, the flow is insensitive to nozzle exit pressure, thus minimizing the possibility of feed-system-boiler coupling instability. The plug and wire helix insert reduces the tendency for slugging. Author

N69-10302# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
THE SWIRLING AXISYMMETRICAL LAMINAR JET
Israel J. Wygnanski Jul. 1968 25 p refs
(D1-82-0741) Avail: Issuing Activity

An exact similarity solution is sought to the equations of motion that apply to all degrees of swirl for an axisymmetrical jet. The Navier–Stokes equations representing the laminar incompressible flow in the spherical polar coordinates are reduced to a similarity form by transformations; a variable step, double precision Runge–Kutta subroutine is used to obtain a numerical solution. The calculations were done by keeping the velocity along the axis of symmetry constant, and varying the degree of swirl and the position of a solid boundary from which the jet originates. It was concluded: (1) The incompressible swirling jet depends on three independent parameters: the linear momentum, the angular momentum, and the wall boundary condition. None of these three parameters can be eliminated without restricting the other two. (2) The swirling jet may exhibit interesting instabilities associated with the increase of swirl and the appearance of an additional inflection point in the axial velocity profile. M.G.J.

N69-10321# Aeronautical Research Labs., Melbourne (Australia).
STATIC PRESSURE HOLE ERRORS ON FOUR SIMPLE SHAPES IN HYPERSONIC FLOW
M. J. Williams May 1968 30 p refs
(ARL/A-299) Avail: CFSTI

The effects of size, aspect ratio and edge geometry have been studied for circular pressure holes on a variety of models in an airstream of M = 7.5. The body shapes which were used, namely the flat plate, cone, circular cylinder and sphere, allowed the influences of different combinations of surface curvature and streamwise pressure gradient to be studied. In addition, the local Mach number was varied by inclining the flat plate model and by changing the cone semiangle. The geometries chosen were also representative of models employed in high speed wind tunnel testing and the results therefore will serve as a guide in the selection of optimum pressure tapping dimensions. Author

N69-10341 Colorado State Univ., Fort Collins.
TURBULENCE IN A HYDRODYNAMICALLY ROUGH AND SMOOTH OPEN CHANNEL FLOW
Raul S. McQuivey (Ph.D. Thesis) 1967 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-2599

An investigation was made of the characteristics of turbulence in a hydrodynamically rough (0.173 inch lead spheres) and a hydrodynamically smooth (commercial plexiglas) two-dimensional open channel flow in water. The study was made using hot-film sensors and a constant temperature anemometer. A procedure was developed to measure turbulent characteristics in contaminated water under many conditions. This method gives reliable and repeatable results when compared with turbulent characteristics measured in well filtered, deaerated water. For flow over the rough boundary in comparison with the smooth boundary, it was found that the longitudinal relative turbulent intensities increased approximately 50 percent close to the boundary (Y/D = 0.10) and 20 percent near the free surface (Y/D = 0.80). Dissert. Abstr.

N69-10399 State Univ. of Iowa, Iowa City.
THE EFFECT OF AN UNSTEADY BOUNDARY LAYER ON THE MOTION OF AN OSCILLATING FLAT PLATE
James Peter Ries (Ph.D. Thesis) 1967 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-970

The motion of an infinite, flat plate undergoing free oscillations as a submerged pendulum in a viscous fluid is analyzed. An analytical solution has been obtained through a simultaneous solution of the equation of motion for the plate, the drag force relationship and the boundary layer equations for the case of laminar, incompressible, unsteady flow. Expressions for the displacement and velocity of the plate appear as the sum of a damped harmonic oscillation and a particular solution which decays asymptotically to zero with increasing time. The period and logarithmic decrement are expressed as functions of a single parameter which contains the physical properties of the fluid and dimensions of the system. Predicted values of plate displacement, plate velocity, amplitude ratio and damped oscillation period are compared to the results of an experimental investigation performed in water and a light oil. Excellent agreement is found between computed and experimental results. Dissert. Abstr.

N69-10405# Southampton Univ., (England). Dept. of Aeronautics and Astronautics.
STABILITY DERIVATIVES OF SHARP WEDGES IN VISCOUS HYPERSONIC FLOW INCLUDING THE EFFECTS OF THICKNESS AND WAVE REFLECTION
W. H. Hui Dec. 1967 60 p refs
(AASU-278) Avail: Issuing Activity

Using a perturbation method, the formulas for the stability derivatives of sharp wedges at zero incidence in viscous hypersonic

flow were obtained in closed form. The results included the effect of unsteady reflected waves from the bow shock and might be applied to any wedges providing the bow shock is attached. The viscosity of the gas was seen to play two roles: first, it thickens the wedge; this introduces the concept of an effective wedge which is thicker than the original wedge by a semivertex angle equal to the average inclination of the displacement boundary layer; secondly, it makes this effective wedge deformable. Comparison with Orlik–Ruckemann's theory is given. Author

N69-10406# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
EXACT THEORY FOR THE STABILITY OF AN OSCILLATING WEDGE IN HYPERSONIC AND SUPERSONIC FLOWS
W. H. Hui Oct. 1967 43 p refs
(AASU-277) Avail: Issuing Activity

The exact perturbation equations for unsteady hypersonic and supersonic flows past a wedge-like body for which the bow shock is attached to the body are solved by expanding the unknown functions in power series in ik, where k is the frequency parameter, and thus exact formulas for the stability derivatives of a wedge with any thickness in hypersonic or supersonic flows are obtained in closed form. Also, an exact criterion for the stability of a wedge and neutral damping boundaries are obtained. Author

N69-10421 Washington Univ., St. Louis, Mo.
ACOUSTIC SHEAR WAVES FOR FLUID INSIDE A CYLINDER
Richard Leo Bussmann (Ph.D. Thesis) 1967 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-17164

For the steady state acoustic vibration of fluid contained in a right circular cylinder, the linear differential equations of motion are changed by the LaPlace transformation and power series expansion into an algebraic matrix equation which is then inverted. The resulting general solution form relates all the boundary value vectors of the system by a determinate matrix containing all the waveforms. The set of compressional waves is found. Each is shown to be accompanied by its radial shear wave of the Sexl type. The elastic wall effects and the shear viscosity perturbations are treated fully. A set of shear waves propagating axially is derived, each with an accompanying radial shear wave. These tube end boundary layer waves complete the theoretical picture and allow matching of arbitrary tangential velocities at the tube ends. The matrix calculus method gives a way to expand arbitrary functions into the characteristic wave functions, and to solve for the unknown boundary value vectors, and thus the full wave field, for any particular system. The numerical solution is difficult, however, and is only carried through partly here. Dissert. Abstr.

N69-10436# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OSCILLATIONS OF A SUPERSONIC GAS FLOW IN A CHANNEL OF FINITE LENGTH WITH OSCILLATING WALLS
D. A. Derbentsev *In its* Appl. Mech. 18 Sep. 1967 p 29–34 refs (See N69-10433 01-32)
Avail: CFSTI

The purpose of this investigation is to determine the pressure distribution on the walls of a cylindrical channel of finite length whose walls oscillate according to a certain law, in the case of supersonic gas flow. The effect of shock wave reflection from the axis is taken into account and the flow is assumed to be potential and isentropic. A linearized equation of small axisymmetric oscillations of gas with respect to perturbation potential is analyzed and boundary conditions are established. The pressure on the oscillating wall is determined by substituting the obtained value in the expression for pressure inside the flow. It is shown that flow parameters are described by functions whose degree of smoothness depends on conditions at the channel entrance. The flow loses "static" stability when a certain correlation exists between the Mach number, wavelength, and frequency of wall oscillations. Author

N69-10443*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REAL-HELIUM HYPERSONIC FLOW PARAMETERS FOR PRESSURES TO 3600 ATMOSPHERES AND TEMPERATURES TO 15,000°K
Charles G. Miller, III and Sue E. Wilder Washington Nov. 1968 43 p refs
(NASA-TN-D-4869) Avail: CFSTI CSCL 20D

The virial form of the equation of state is used to derive a method for determining reservoir, nozzle-throat, free-stream, and normal-shock conditions for real-helium flow. This method is derived primarily to meet the needs of hotshot-type wind tunnels where the basic input data are measured reservoir pressure and stagnation pressure behind a normal shock. However, the method is derived to include an additional measurement of free-stream density, free-stream velocity, or reservoir temperature. The method is applied for reservoir pressures to 3600 atmospheres, temperatures to 15,000°K, and a range of free-stream Mach numbers from 10 to 100, and the results are presented in the form of nondimensionalized reservoir thermodynamic and nozzle-throat parameters and as simple correction factors which may be applied to ideal-helium flow parameters. These calculations are restricted to reservoir densities less than the critical density of helium and to theoretically uncondensed free-stream flow. Author

N69-10465*# Houston Univ., Tex.
BASIC RESEARCH IN TOPOLOGY
D. R. Traylor 1968 11 p
(Grant NGR-44-005-037)
(NASA-CR-97572) Avail: CFSTI CSCL 12A

Proximity spaces and topological spaces were examined to establish a theory of integration that does not require local compactness. In a regular developable topological space it was found possible to establish such a theory provided the space was a hedgehog or a highly restricted space in which each point is either an interior point of an arc or an end point common to many arcs. Similar results were found for proximity spaces, and each proximity space was found to give rise to a topological space such that the topology agrees with the proximity space. The proximity space was so highly restricted that the anticipated value of relaxation of the local compactness condition did not find fruition. Covering properties were investigated with particular attention to the property of countable paracompactness. During the study of determining whether each normal, regular, developable topological subspace was a subspace of a complete, regular, and developable normal space, regularity was sacrificed to acquire completeness. Each semi-metric space was found to be a dense subspace of a strongly complete and semi-metric space. M.W.R.

N69-10467# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
INSTABILITIES IN FLOW THROUGH MULTIROD BUNDLES AND THEIR EFFECT ON DRYOUT
M. B. Carver, D. F. D'Arcy, G. A. Wilhammer, J. E. Casterline (Columbia Univ., N. Y.), and B. Metzner (Columbia Univ., N. Y.) Sep. 1968 20 p refs Paper presented at the Intern. Symp. on Res. in Cocurrent Gas-Liquid Flow held at Waterloo Univ., Ontario, 18–19 Sep. 1968 *Its* Paper No. D4
(AECL-2716) Avail: Atomic Energy of Can., Ltd., Chalk River: $0.50

Flow instability experiments have been done on electrically heated 19-element bundles in a forced circulation water loop. To simulate parallel channel geometry, an unheated flow bypass was connected in parallel with the test section. The heated length was nine feet; maximum bundle power was 3.5 MW. Test section flows to 300 lb/ft², inlet subcoolings from about 20°F to 180°F, and

outlet pressures of 150, 500, 750, 1000 psia, were tested. Each test was terminated at the occurrence of a sustained oscillation of the test section flow, dryout, or both. Comparable tests were also made with the bypass valved out, and flow oscillations did not occur. These tests were terminated on the appearance of dryout. Flow stability in the bundle was also assessed using a computer code POISE, which had been developed previously and had shown good agreement with experiments on heated channels of simple geometry. The code predicts onset of flow oscillations at power slightly lower than experimental points. Author

N69-10472*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

USE OF BARONTI-LIBBY TRANSFORMATION AND PRESTON TUBE CALIBRATIONS TO DETERMINE SKIN FRICTION FROM TURBULENT VELOCITY PROFILES

Jerry M. Allen Washington Nov. 1968 41 p refs

(NASA-TN-D-4853) Avail: CFSTI CSCL 20D

A large number of velocity profiles with corresponding local skin friction measurements have been used to investigate the validity of the Baronti-Libby transformation as a skin friction measuring technique over a wide range of test conditions. The possibility of using existing Preston tube calibrations to calculate skin friction from velocity profiles is investigated, and a computational procedure is developed so that a Clauser-type determination of skin friction from velocity profiles can be accomplished without the necessity of plotting. The principal conclusions that result from this study are that the Baronti-Libby transformation gives good results for adiabatic flow but does not predict the correct trend with heat transfer and that using the Fenter-Stalmach law only as a Preston tube calibration is unduly restrictive since it is shown that the law can be used to calculate local skin friction from conventional velocity profiles with results that are comparable with those of the more complex Baronti-Libby method. Author

N69-10557# Politecnico di Torino (Italy). Istituto di Meccanica Applicata.

COMPRESSIBLE LAMINAR SKIN-FRICTION LAW

Gianni Jarre Mar. 1968 19 p refs

(Grant AF-EOAR-28-66)

(AD-674292; AFOSR-68-1745; SR-6; TR-42) Avail: CFSTI CSCL 20/4

The previously derived incompressible skin-friction law is extended to compressible fluids and applied to the study of flows with zero-pressure gradient and of the compressibility effects on the separation point. The proposed method is very easy to deal with. It yields accurate results when compared with precise solutions. Author (TAB)

N69-10563# Imperial Coll. of Science and Technology, London (England).

SOME APPLICATIONS OF A NEW CALCULATION PROCEDURE FOR THE TURBULENT BOUNDARY LAYER

D. B. Spalding Jul. 1967 27 p refs Presented at the Heat Transfer Conf., Minsk, USSR, May 1968

(TWF/TN/28) Avail: CFSTI

Predictions are made of velocity and temperature profiles, and of heat and momentum transfer rates, in axisymmetrical turbulent jets, some film cooling flows, and numerous boundary layers on smooth walls in the presence of pressure gradients. The calculations are effected by means of a new finite difference procedure. The physical basis is a special form of the Prandtl mixing length hypothesis. The predictions are compared with experimental data. The agreement is satisfactory in most cases. Author

N69-10604# New York Univ., N. Y. Dept. of Aeronautics and Astronautics.

NUMERICAL SOLUTION OF THE INCOMPRESSIBLE AND COMPRESSIBLE LAMINAR BOUNDARY LAYER EQUATIONS WITH ASSIGNED CONSTANT WALL SHEAR STRESS

Victor Zakkay and Edgar Alzner May 1968 71 p refs

(Contract Nonr-285(63))

(AD-674532; NYU-AA-68-13) Avail: CFSTI CSCL 20/4

Numerical solutions of the boundary layer equations with arbitrary initial profiles and an assigned constant wall shear stress were carried out. Results show that after an initial non-similar flow all initial profiles for incompressible flow asymptotically approach similar profiles corresponding exactly to the Falkner-Skan similar solution. The streamwise distance required for any arbitrary initial profile to approach this similar profile depends upon the extent of departure of the initial profile from the beta = 1/2 similar profile (the larger the difference the longer the distance). For compressible boundary layers, constant wall shear stress solutions give rise to asymptotic locally similar profiles, with no particular similar profile having been determined in the present analysis. Author (TAB)

N69-10640# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

A COMPARISON OF METHODS FOR COMPUTING THE EIGENVALUES AND EIGENVECTORS OF A MATRIX

I. Galligani Brussels 1968 103 p refs

(EUR-4055.e) Avail: CFSTI

In this report a comparison of some methods for solving the eigenproblem of a matrix is given. An attempt has been made to establish the efficiency, on the basis of computing time and accuracy, of each method by carrying out experimental calculations on representative problems for which exact results are known. In order to pick out the best methods we collect a list of matrices with different condition numbers which form a representative sample of those which occur in practice. Some relationships between these condition numbers are discussed. Finally the results of some computational experiments carried out on the above test matrices are presented. Author

N69-10684# National Research Council of Canada, Ottawa (Ontario).

A FIBONACCI SEARCH ALGORITHM FOR THE APPROXIMATE MINIMIZATION OF A FUNCTION OF A SINGLE VARIABLE

Peter J. Trushel Mar. 1968 53 p refs

(NRC-10378; MK-24) Avail: CFSTI

The Fibonacci search method for determining the minimizing argument of a unimodal function is summarized. A computer program for implementing this search method is presented. The concepts of n-search, search algorithm, mini-max n-search, and a mini-max n-search are introduced and employed to develop the Fibonacci search method when only two function evaluations are permitted. A lower bound for the smallest detectable difference between two numbers represented by d decimal digits on a digital computer is also given. Author

N69-10693*# National Aeronautics and Space Administration, Washington, D. C.

SOME FLUID MECHANICAL PROBLEMS RELATED TO SUBSONIC AND SUPERSONIC AIRCRAFT

John T. Howe, ed. 1968 24 p refs

(NASA-SP-183) Avail: CFSTI CSCL 01A

Some of the problems connected with modern subsonic and supersonic aircraft and which have their origin in fluid mechanical phenomena are reviewed. The following topics are discussed and found to require further study: 1. Turbulent boundary layers, including the effects of three dimensionality and adverse pressure gradients; 2. Separated flows, such as are due to adverse pressure gradients, to shock boundary layer interactions including the transonic problem, and to concavities; 3. Vortex flows, such as arise from wings and fuselages at angles of attack; 4. Correlation of wind tunnel measurements with flight data and other wind tunnel

data; and 5. Transonic flows, including two dimensional airfoil design, integration of wings and fuselage, and methods of increasing the critical Mach number. Author

N69-10722# Dynatech Corp., Cambridge, Mass.
FILM THICKNESS AND CRITICAL HEAT FLUX OBSERVATIONS FOR HIGH PRESSURE WATER IN SPRAY ANNULAR FLOW
A. E. Bergles and J. P. Roos [1968] 39 p refs Presented at Intern. Symp. on Res. in Cocurrent Gas-Liquid Flow, Waterloo, Ontario
(Contract AT(30-1)-3304)
(CONF-680903-1) Avail: CFSTI

Film thickness measurements are reported for steam-water mixtures flowing in circular tubes and a rod bundle at 1000 psia. A traversing electrical probe of the needle-contact type was developed for these measurements. Adiabatic films are shown to be thicker than predicted by available models, due to entrained vapor. By observing the film behavior, it was possible to adjust an annular mixer so as to avoid irregular film behavior. With the exception of very high mass velocities, the film thickness for both subcooled and mixed inlet conditions proceeds smoothly to zero as the critical heat flux condition is approached. For similar local flow conditions, thicker films are observed away from dryout in 0.8 in. tubes than in 0.4 in. tubes; however, critical heat fluxes are higher for 0.4 in. tubes. Wide variations in film thickness are observed in various subchannels of the rod bundle. Author (NSA)

N69-10777# Sandia Corp., Albuquerque, N. Mex.
FLUID TYPE LOGIC ELEMENTS [ELEMENTI LOGICI A FLUIDO]
Carlo Torresan 1968 15 p Transl. into ENGLISH from Riv. Ing. (Milan), no. 17, 1968 p 715–720
(SC-T-68-1534) Avail: CFSTI

Fluid-type logic elements without moving parts or with parts subjected to micromovements are described. Boolean algebra, digital amplifiers, proportional amplifiers, membrane elements, and auxiliary organs are discussed. NSA

N69-10788*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BLUNT BODY STAGNATION REGION FLOW WITH NONGRAY RADIATION HEAT TRANSFER: A SINGULAR PERTURBATION SOLUTION
Walter B. Olstad Washington Nov. 1968 83 p refs
(NASA-TR-R-295) Avail: CFSTI CSCL 20D

A singular perturbation solution to the blunt-body stagnation region flow of an inviscid, radiating gas has been obtained by means of the Poincare-Lighthill-Kuo, or perturbation-of-coordinates, method. A number of results for a gray gas have been presented in order to provide some physical insight into the effects of various parameters on the shock-layer enthalpy profiles and the radiant heat-transfer rates. A nongray absorption coefficient model was developed which includes, in an approximate way, the important vacuum ultraviolet contributions of bound-free and line transitions. This model was used to obtain solutions pertinent to the case of reentry into the earth's atmosphere. While the results are restricted to small values of the radiation cooling parameter, which characterized the relative importance of radiation and convection as energy transport mechanisms, they cover broad ranges of vehicle velocity, altitude, and nose radius, which are of practical interest. Author

N69-10795# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.
IMPACT PRESSURE MEASUREMENTS IN HYPERVELOCITY, LOW DENSITY ARC HEATED FLOW [PITOTSONDENMESSUNGEN IN HYPERGESCHWINDIGKEITSSTROEMUNGEN GERINGER GASDICHTEN UND HOHER GESAMTENTHALPIEN]
K. Kindler Jul. 1968 42 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-42; DVL-773) Avail: CFSTI

Results of Measurements with cooled hemispherical and flat nosed impact pressure probes in arc heated, low density Argon flow are reported. The data are compared with those of former experimental and theoretical reports. Finally it is tried for a physical explanation of the deviations of impact pressure measurements from the inviscid values in flows of rarefied gases. Author

N69-10802*# Techtran Corp., Glen Burnie, Md.
SOME RESULTS OF THERMAL CHARACTERISTICS OF TURBULENT BOUNDARY LAYERS AT HIGH TEMPERATURE [QUELQUES RESULTATS SUR LES CARACTERISTIQUES THERMIQUES DES COUCHES LIMITES TURBULENTES A TEMPERATURE ELEVEE]
R. Michel et al. Washington NASA Oct. 1968 32 p refs Transl. into ENGLISH from AGARDograph 97, pt. 1, May 1965 p 65–96
(Contract NASw-1695)
(NASA-TT-F-11961) Avail: CFSTI CSCL 20D

An analysis is presented on turbulent boundary layers at temperatures sufficiently high for dissociation to occur. The enthalpy distributions and the concentration in a flat plate boundary layer are studied by means of a combination of the local boundary layer equations in the cases of the perfect gas and of the real gas either frozen or at equilibrium. The ratio of the heat flux to the wall friction is thus decided. The results obtained are used to calculate the heat transfer on rounded forebodies by integration of the global energy equation. Author

N69-10804*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT TRANSFER AND PRESSURE DISTRIBUTIONS DUE TO SINUSOIDAL DISTORTIONS ON A FLAT PLATE AT MACH 20 IN HELIUM
James P. Arrington Washington Nov. 1968 49 p refs
(NASA-TN-D-4907) Avail: CFSTI CSCL 01A

An experimental investigation was conducted to determine the effects of a two-dimensional repetitive sine-wave distortion on the pressure and heat-transfer distributions. Tests were made on a sharp flat plate with a distorted section in a relatively thick boundary layer which changed from laminar to transitional for certain test conditions. The tests were conducted in helium at free-stream Mach numbers of about 20, over a range of length Reynolds numbers varying from 2.72×10^6 to 8.80×10^6 with the flat-plate surface at angles of inclination of 0°, 5°, and 10°. The results of the present tests were similar to results obtained in air at lower free-stream Mach numbers and Reynolds numbers with relatively thinner boundary layers. The pressure and heat-transfer distributions were greatly altered in the distorted section (oscillating from maximum to minimum values) with the heating distribution being affected the most. The magnitude of these pressure and heat-transfer oscillations also depended on whether the flow was laminar or transitional. However, the values generally approached the undisturbed flat-plate results a short distance downstream of the distorted region. Author

N69-10881*# North American Rockwell Corp., Downey, Calif. Space Div.
SIMULATED HIGH REYNOLDS NUMBER FLOW ABOUT A CIRCULAR CYLINDER Final Report
B. H. Ujihara Oct. 1968 119 p refs Revised
(Contract NAS2-4327)
(NASA-CR-73288; SD-68-332) Avail: CFSTI CSCL 20D

A numerical analysis method, based upon potential theory, is presented for solving the problem of high Reynolds number flow about a circular cylinder. The three approaches used are described and assessed: (1) a method based upon statistical sampling of discrete vortex velocity contribution; (2) a method based upon influence coefficients employing a polar grid system; and (3) a method based upon influence coefficients using a Cartesian grid system. The numerical results achieved indicated that the first two approaches, while featuring rapidity of solution, did not incorporate adequate control of numerical accuracy. The third method incorporated controlled numerical accuracy and a more optimal utilization of the influence coefficient approach for the high Reynolds number problem. A computer program developed for this method demonstrated that the critical computer limitation lies in computational speed rather than size of core storage. It is believed that a generation of computers featuring two orders of magnitude faster computational speeds are required before flows in the 10 million Reynolds number regime may be fully analyzed. Author

N69-10941#
ACOUSTIC PRESSURE IN A FLUID FILLING A CYLINDRICAL SHELL AND FLOWING EXTERNALLY ALONG ITS GENERATOR
V. N. Goncharenko [1968] 4 p ref Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), Ser. A, Fiz.-Tekh. i Mat. Nauki, no. 8, 1968 p 760–763
Avail: CFSTI

A thin cylindrical shell filled with a fluid is considered that has a fluid of the same density flowing around its exterior. The acoustic pressure in the filler fluid is determined, neglecting the influence of boundary conditions at the shell ends by considering the shell infinite. Attention is also given to the forced vibrations of a shell filled with fluid and in an inviscid flow. The necessary equations are detailed, and transforms are introduced to solve these shell equations. M.W.R.

N69-10953# National Aerospace Lab., Tokyo (Japan).
EXPERIMENTAL STUDY OF LOW DENSITY HYPERSONIC FLOW BY USING THE ELECTRON-BEAM DENSITOMETRY
Isamu Wada and Kunio Soga 1968 19 p refs In JAPANESE; ENGLISH summary
(NAL-TR-157) Avail: CFSTI

Hypersonic low density flow has been investigated by using a shock tunnel and electron-beam densitometers. The absorption and fluorescence methods of electron-beam densitometry have been developed for flow measurement in the test section of the shock tunnel. A flat plate with a sharp leading edge is investigated in a hypersonic flow having a Mach number of 8.5 and Reynolds numbers of 16000, 2000, 1000 per centimeter. The induced surface pressures near the leading edge at small Reynolds numbers were significantly smaller than those predicted by the strong and weak interaction theory. The hypersonic low-density wakes behind spheres 0.2 cm and 0.395 cm in radii and a cylinder 0.195 cm in diameter were also investigated. The radial density distributions across the shock layer and the wake at various distances downstream from the spheres are measured at free-stream Mach numbers of 7.35, 8.9 and Knudsen numbers (based on the radius of the sphere and the diameter of the cylinder) from 0.056 to 0.25. Density distribution along the stagnation stream line ahead of the cylinder are also presented in comparison with Bird's numerical results. The future problem of hypersonic flow in the region of transition from free-molecule flow to continuum flow is discussed. Author

N69-10956*# Purdue Univ., Lafayette, Ind. Heat Transfer Lab.
IMPROVED FLUID DYNAMICS SIMILARITY, ANALYSIS AND VERIFICATION. PART 3: TWO-PHASE FLOW IN VIBRATING DISCHARGE LINES Final Report, 29 Jun. 1965–28 Jun. 1968
R. W. Griebe, E. R. F. Winter, and R. J. Schoenhals Jul. 1968 179 p refs
(Contract NAS8-20222)
(NASA-CR-97742) Avail: CFSTI CSCL 20D

An analytical and experimental investigation of two phase flow in a discharge line with a sharp edged entrance is presented for both vibratory and non-vibratory conditions. An extensive experimental investigation showed that vibration of the test section generally caused an increase in pressure losses. A modified cavitation number was developed based on a free streamline analysis which considered the flow into the sharp-edged entrance as flow from an orifice. Good agreement with experimental data was shown to exist for several different geometric configurations. An analytical model describing choked two-phase flow was developed using the free streamline theory. No effect of vibration on choked flow was detected experimentally. In particular, equations defining the minimum pressure drop for choked flow and equations predicting the shock position as a function of the stagnation pressure loss are given. Good agreement between the analytical predictions and experimental data was obtained in both cases. Author

N69-10988# National Aerospace Lab., Tokyo (Japan).
EFFECTS OF CURVATURE ON THE SIMILAR STRUCTURE AND TURBULENT MIXING OF TWO-DIMENSIONAL CURVED JETS
Hiroshi Endo 1968 18 p refs In JAPANESE; ENGLISH summary
(NAL-TR-158) Avail: CFSTI

The structure of two-dimensional curved jets issuing from the trailing edge of a wing (jet flap) was studied to determine the effects of curvature on the turbulent mixing process. It is verified that a mass flow exists across the jet centerline and that this compensates for the effect of the different rates of entrainment at the two edges of the curved jet, and eventually preserves the nearly symmetric similar profile of flow velocity. The turbulent structure of the jet is self-preserving except in the initial mixing region, where turbulence is rapidly growing and is not in equilibrium. On the basis of dynamic similarity thus established, the similar solution of Reynolds' equations of motion for two-dimensional curved jets is derived using Sawyer's expression for the turbulent shear stress. The formula relating the curvature factor to the parameters of the velocity profile and the cross-flow velocity at the jet centerline is derived. The conclusions of the theoretical analysis are examined in the light of the experimental results. The hypothesis of inviscid jets underlying the current jet flap theories, which states that the pressure difference Δp across the jet is expressed by $\Delta p = KJ$ (where K is the curvature of the jet and J is the rate of momentum flow), is examined in view of the effects of entrainment on the pressure field across the jet. Author

N69-10971*# Brown Univ., Providence, R. I. Div. of Applied Mathematics and Engineering.
ON THE CONTROL OF A LINEAR FUNCTIONAL-DIFFERENTIAL EQUATION WITH QUADRATIC COST
Harold J. Kushner and Daniel I. Barnea [1968] 28 p refs Sponsored in part by AF Office of Sci. Res. and NSF
(Grants NGL-40-002-015; NSF GK-2788; AF-AFOSR-693-67)
(NASA-CR-97626) Avail: CFSTI CSCL 12A

This paper is concerned with finding the control u(·) which minimizes the quadratic functional $V^u(x_t,t) = \int_t^T [x'(s)M(s)x(s) + u'(s)N(s)u(s)]ds$, where M(s) and N(s) are continuous, $M(s) \geq 0$, and $N(s) > 0$ for each s in [0,T]. The study is part of an attempt to use the theory of stochastic delay equations to study certain approximations to nonlinear filters, and to stabilize a system when only noise corrupted observations are available. S.C.W.

N69-11016
ON THREE-DIMENSIONAL WAVES IN THE BOUNDARY LAYER
S. Ia. Gertsenshtein [1968] 6 p refs Transl. into ENGLISH from Izv. Akad. SSSR, Mekh. Zhidk. i Gaza, no. 4, 1968 p 98–102
Avail: CFSTI

Two dimensional waves are developed in the boundary layer, which are regenerated as three dimensional waves as the Reynolds number increases. It is shown in a linear formation that spatially increasing perturbations cannot possibly explain the appearance of three dimensional waves. The difficulties which originate in solving the considered problem are well known, and are explained by the presence of a small parameter in the highest derivative in the Orr–Sommerfeld equations. The problem of stability of a viscous incompressible fluid flow in the boundary layer of a lengthwise streamlined flat plate reduces to the solution of an eigenvalue problem for the Orr–Sommerfeld equation with homogeneous boundary conditions. Author

N69-11022# Oak Ridge National Lab., Tenn.
INVESTIGATION OF THE INTERACTION OF SOLID PARTICLES WITH FLUIDS IN TURBULENT PIPE FLOW
Craig A. Brandon (Ph.D. Thesis—Tenn. Univ.) Sep. 1968 181 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2124) Avail: CFSTI

The heat transfer to liquid-solid suspensions was studied. It was hypothesized that the enhancement of the heat transfer film coefficient in dilute suspensions may attain a maximum for particle sizes in the order of the Kolmogoroff microscale of the pipe flow turbulence. Information for water-solid suspensions was obtained to provide an additional test of this hypothesis. The heat transfer to water-solid suspensions of ten sizes of glass microspheres was measured for horizontal and upward vertical transport in 1-in. diameter steam heated pipes. The mean diameters of the uniformly-sized microspheres were 20, 32, 50, 60, 70, 100, 170, 370, 560, and 860 microns. The transport velocity range corresponded to Reynolds numbers from 20,000 to 90,000. A constant temperature hot-film anemometer was used to measure the longitudinal turbulence intensity within the central core of horizontal pipe flow of water and water-solid suspensions. Suspensions of 20, 32, 50, and 60 micron particles were studied. The particles had no measurable effect on the turbulence intensity. The effects of several sizes of particles on the pressure drop in the downstream region of a long ($L/D \approx 95$) horizontal test section were also measured. The water-solid suspension data were also consistent with the hypothesis of maximum enhancement of the film coefficient for particles sizes near the Kolmogoroff microscale.
Author (NSA)

N69-11047# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
TWO PHASE LIQUID-GAS FLOW THEORY, PART 2 [TEORIA DEI MOTI BIFASI LIQUIDO-VAPORE, PARTE 2]
G. Basso 1968 103 p refs In ITALIAN; ENGLISH summary
(RT/ING(68)15) Avail: CFSTI

The scope of this study is to show that thermohydrodynamic instabilities, such as burn out, and the various two phase flow patterns can be physically interpreted and analytically described on a thermodynamic basis, if the compressibility and the thermal expansion of the fluid are taken into account. The exact theoretical equations which make it possible to determine the critical flow conditions are derived, analyzed and compared with the experimental results. In the first part of the study the present status of fluid mechanics and vibration theory have been examined with the aim of evaluating the limits of their validity, in the case of diabatic and two phase flows. In this second part similarities of permanent and periodic flow are pointed out and the general conditions for stability and instability are found; the need of two new concepts for a correct analysis of flow phenomena is stressed: (a) Thermodynamic cross section and (b) current density; new theories of friction and sonic flow are developed in adiabatic and diabatic conditions; finally the critical values of friction, fluid velocity and enthalphy for transition to periodic flow and thermal instability are determined and analyzed. Author

N69-11137#
GAS JET INJECTION INTO A SUPERSONIC STREAM FROM ORIFICES IN THE LATERAL SURFACE OF A BODY
A. I. Zubkov et al. [1968] 7 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Mat., Mekh., (Moscow), no. 5, 1968 p 66–72
Avail: CFSTI

Magnitude of the Mach number of the injected jet, diameter of the orifice for injection, and ratio of total jet pressure to static free-stream pressure were considered in terms of gas jet injection into a supersonic stream and the flow configuration near and within the jet. The air jet was injected from a flat plate through orifices of 3.2, 6.81, 12, and 14 mm into a Mach 3 stream; with jet Mach numbers of 1, 2, 2.61, and 3 and a turbulent boundary layer on the plate. There was a separation of the boundary layer from the compression shock configuration within and in front of the jet; and the flow in the separation zone, the shape of the separation line, and the characteristic lengths of the separation flow domain depended primarily on the configuration which the injected jet assumed. Dependence of the jet width and depth of penetration in the main flow on pressure and orifice diameter was studied.
M.W.R.

N69-11198# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
MOLECULAR MIXING RATE IN THE INITIAL SECTION OF A TURBULENT JET
N. A. Zamyatina et al 26 Jun. 1968 19 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Izv., Energ. i Transp., no. 3, 1965 p 137–143
(Contract NOw-62-0604)
(AD-675174; APL-CLB-3-T-556) Avail: CFSTI CSCL 20/4

In studying processes taking place in various furnace installations it becomes necessary to investigate molecular exchange, which plays a decisive role in chemical reactions during diffusion burning. Experimental data show that molecular exchange is more intensive in a turbulent flow than in a laminar one. A physical model is used to describe turbulent flow which permits consideration of two types of exchange: turbulent (turbulent diffusion) and molecular accelerated by turbulence (accelerated molecular diffusion). Based on physical concepts of the process of turbulent mixing of a jet and a wake flow statistical parameters are introduced, which are necessary for the analytical description of the flow problem being considered. Results are given of an experimental study of the mixing rate of a turbulent jet to the point of molecular homogeneity.
Author (TAB)

N69-11218# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A SUPERSONIC JET OF HYDROGEN IN A VACUUM
V. B. Yuferov, V. A. Kovalenko, and Ye. I. Skibenko 5 Jan. 1968 7 p refs Transl. into ENGLISH from Akad. Nauk Ukr. SSR, Inst. Fiz.-Tekhn. Dokl. (USSR), no. 53, 1964 p 3–4
(AD-675442; FTD-HT-23-1400-67) Avail: CFSTI CSCL 20/4

The possibility of obtaining a supersonic hydrogen jet, was studied based on the successful application of cryogenics in creating supersonic jets of CO_2, Ar, and N_2 gas. A hydrogen jet can be realized when the thermal load on a surface washed by a jet of helium is .001 to .01 W/sq cm. A supersonic hydrogen jet can be used successfully to recharge intense ion beams in installations in which injection of fast neutral hydrogen or deuterium atoms is used to create hot plasma.
Author (TAB)

N69-11223# United Kingdom Atomic Energy Authority, Wantage (England). Research Group.
ACCURACY OF OPEN CHANNEL FLOW MEASUREMENTS USING RADIOACTIVE TRACERS
D. B. Smith, P. L. Wearn, and T. V. Parsons Jun. 1968 13 p refs
(AERE-R-5676) Avail: CFSTI

Three radioisotope techniques can be used for flow measurement. These are the constant rate injection method, the sudden injection method with continuous sampling of the tracer, and the sudden injection method with integrated in situ measurement of tracer (the total count method). The continuous sampling method is considered to be the most suitable for accurate and reliable river flow measurement. This technique is of particular value for the calibration and checking of hydraulic structures such as weirs and flumes. The series of measurements discussed were undertaken to examine and improve the accuracy of the technique, using a variable flow recirculating flume in which the flow was measured volumetrically. Author (NSA)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N69-10003 Illinois Univ., Urbana.
THE APPLICATION OF PULSE COMPRESSION TECHNIQUES TO IONOSPHERIC SOUNDING
Donald Richard Wippermann (Ph.D. Thesis) 1967 236 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.05 Order No. 68-1886

Contemporary radar systems frequently employ pulse compression techniques to enhance the spatial resolution properties of a moderate peak power emission. This same technique has been applied within a vertical incidence ionospheric sounding system. The ionosonde developed to establish the feasibility of pulse compression ionospheric sounding emits a one to two kilowatt peak power, 1.6 millisecond, linear FM pulsed waveform containing a swept frequency bandwidth of 40 KHz. Since upon reception of ionospheric echoes, matched filter processing techniques are utilized, the ionosonde has a system sensitivity and a virtual height resolution equivalent to a conventional ionosonde which emits 64-128 kw of peak power within a 25 microsecond, pulsed RF emission. In addition to the complete description of the pulse compression ionosonde system design the first four chapters contain a detailed analytical presentation of the generation and processing of the pulse compression waveform. Dissert. Abstr.

N69-10132*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
THE LOW FREQUENCY CUTOFF OF ELF EMISSIONS Progress Report, May 1968
Donald A. Gurnett and Thomas B. Burns May 1968 34 p refs
(Grant NGR-16-001-043; Contract Nonr-1500(08))
(NASA-CR-97453; AD-673325; Rept.-68-28) Avail: CFSTI CSCL 04A

ELF and VLF radio noises observed by satellites in the ionosphere often have a very sharp lower cutoff frequency near the proton gyrofrequency. The paper summarizes the experimentally observed characteristics of this low frequency cutoff and proposes an explanation for the cutoff based on the reflection of downward propagating, extraordinary mode, waves near the two-ion cutoff frequency between the proton and helium gyrofrequencies. This explanation, if correct, provides the first direct evidence that chorus and ELF hiss emissions are generated at high altitudes (above 3000 km) and not near the base of the ionosphere. Ground-based observations of 700 HZ noise bands near the auroral zone, previously attributable to proton cyclotron radiation at low altitudes in the ionosphere, can now be explained by this reflection mechanism. Other possibly related effects (such as multiple ELF noise bands and the reflection of whistlers at the two-ion cutoff frequency) are discussed. Author (TAB)

N69-10326*# Volt Technical Corp., Washington, D. C.
DETERMINATION OF THE DIMENSIONS OF THE MAGNETOSPHERE, AS MEASURED BY THE SUBSOLAR DISTANCE, FROM THE DATA OF TERRESTRIAL OBSERVATIONS OF GEOMAGNETIC MICROPULSATIONS
V. A. Troitskaya, R. V. Shchepetnov, and A. V. Gul'el'mi 7 Nov. 1968 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 182, no. 5, 1968 p 1063–1066
(Contract NAS5-12487)
(NASA-CR-97456; ST-GM-PF-10768) Avail: CFSTI CSCL 04A

The geomagnetic micropulsations of the type Pc 2–4, are used for the determinations of the dimension of the magnetosphere as measured by the subsolar distance, since they are, in fact, the magnetosphere's proper hydromagnetic oscillations excited at its periphery by solar corpuscular streams. This method is considerably improved by simultaneous measurements in a wide range of magnetic field suddun impulses at the equator. Author

N69-10373*# National Aeronautics and Space Administration, Washington, D. C.
BIBLIOGRAPHY OF SOVIET PUBLICATIONS ON THE INVESTIGATION OF THE UPPER LAYERS OF THE ATMOSPHERE AND OUTER SPACE [BIBLIOGRAPHIYA SOVETSKIKH PUBLIKATSIY PO ISSLEDOVANIYU VERKHNIKH SLOYEV ATMOSFERY I KOSMICHESKOGO PROSTANSTVO]
Nov. 1968 88 p refs Transl. into ENGLISH from "Issledovaniya Verkhney Atmosfery i Kosmicheskogo Prostranstva, Vypolnennyye v SSSR v 1967 Godu" Moscow, Nauka, 1968 p 87–139
Presented at 11th Meeting of COSPAR, Tokyo
(NASA-TT-F-12019) Avail: CFSTI CSCL 03A

This bibliography of Soviet publications dealing with the investigation of the upper atmosphere and outer space is comprised primarily of works published in 1967. It is divided into sixteen major categories and contains more than 950 entries. Author

N69-10384*# Texas Univ., Austin. Dept. of Civil Engineering.
A SOLUTION OF NONLINEAR PLANE STRAIN PROBLEMS IN DYNAMIC SOIL MECHANICS
Issa Sebeitan Oweis and William R. Cox Oct. 1968 171 p refs
(Grant NsG-604)
(NASA-CR-66715) Avail: CFSTI CSCL 08M

A theoretical study was performed to define the response of a cohesionless sand of medium density to different rates of loading. The deformation properties were assumed to be represented by two nonlinear curves representing axial strain vs. the deformation modulus and axial strain vs. the lateral strain ratio. A theoretical analysis was performed to support this assumption. The general case of finite deformation was considered. The problem investigated was the penetration of a rigid plate into a vertical surface bounded by a horizontal surface. The force deformation histories under different rates of loading were obtained, as well as the stress distribution in the soil mass. An empirical formula, based on theoretical results, was suggested to relate the ultimate load to the rate of loading. An elasto-plastic analysis was also suggested. An iterative process using the point relaxation technique was utilized to solve the nonlinear equations. A computer program was written for that purpose. Author

N69-10386# Chicago Univ., Ill. Dept. of Geophysical Sciences.
STATISTICS OF INSTANTANEOUS FREQUENCY AND AMPLITUDE AS RELATED TO THE DOPPLER SPECTRUM
R. C. Srivastava and R. E. Carbone 20 Jun. 1968 37 p refs
(Grant NSF GA-819)
(TR-6) Avail: Issuing Activity

The distribution of the instantaneous frequency and power of the signal associated with a given Doppler spectrum is investigated for two cases: Case A: the power at any frequency of the Doppler spectrum is Rayleigh distributed and Case B: the power at each frequency is determinate. It is found that in Case A, the joint distribution of the instantaneous power and frequency depends only on the total power, the mean, and the variance of the Doppler power spectrum. This result holds to a first approximation for Case B also. The distributions of instantaneous power, instantaneous frequency, average power as a function of instantaneous frequency, average frequency as a function of instantaneous power, and variance of power as a function of instantaneous frequency are also obtained. In particular, it is shown that the mean of the instantaneous frequency is equal to the mean power-weighted frequency of the Doppler spectrum. Author

N69-10387# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
METHODS OF UPDRAFT ESTIMATION WITH DOPPLER RADAR
R. Tatehira and R. C. Srivastava 29 Jul. 1968 31 p refs
(Grant NSF GA-919)
(TR-7) Avail: Issuing Activity

Estimation of updraft speeds from various forms of Doppler data is reexamined. The average velocity of the Velocity-Azimuth Display (VAD) pattern is due to the combined effects of horizontal wind divergence, updraft and terminal fall velocity of the scatterers. Of these, the divergence and updraft are related to one another through the continuity equation. Assuming model vertical profiles of divergence, the relative contributions of divergence and updraft to the average of the VAD pattern are computed. It is found that the contribution of divergence dominates at elevation angles below 20°, and is unimportant at angles above 80°. Therefore, measurements of divergence can be made at elevation angles less than 20°; the divergence may then be integrated vertically to provide the updraft. In the case of zenith pointing Doppler radar data, a family of particle size spectra corresponding to a variety of assumed updraft velocities may be computed. The characteristics of the deduced size spectra, such as liquid water content and spread of the size spectrum vary with the assumed updraft. The calculated water content varies with the assumed updraft at about 4 dB/m sec^{-1} regardless of the variance of the Doppler spectrum. Author

N69-10411*# Illinois Univ., Urbana. Engineering Experiment Station.
MEASUREMENT OF IRREGULARITY HEIGHTS BY THE SPACED RECEIVER TECHNIQUE
Lawrence M. Paul Sep. 1968 42 p refs
(Grant NGR-14-005-002)
(NASA-CR-97603; TR-36) Avail: CFSTI 04A

Scintillation of radio signals from an artificial earth satellite has been analyzed using the spaced receiver technique in order to gain a greater understanding of the latitudinal and diurnal variation of the height of the electron irregularities responsible for the observed scintillation on the ground. The irregularity heights tend to be greater during the nighttime hours than during the midday hours. Also, the average irregularity height increases towards the north. This increase appears to be due to the existence of small patches of irregularities occurring at higher heights to the north. A large portion of the data falls in the 300–450 km range and thus confirms the observations of others. A regular type of fading has been observed on many occasions. This regular scintillation is compared to that observed by others and an argument is presented which tends to refute use of the sharp edge diffraction model as an explanation for this phenomenon. Also, irregularity patches at the same sub-ionosphere latitude but at different heights were observed and this phenomenon is discussed. Author

N69-10424# San Jose State Coll., Calif. Dept. of Meteorology.
AIR TRAJECTORIES IN THE SAN FRANCISCO BAY AREA
D. Ahrens and A. Miller Sep. 1968 99 p refs
(Grant NSF GA-1090)
(Rept.-5) Avail: Issuing Activity

This report contains plots of the trajectories and, in some instances, the velocities and positions in the vertical of constant volume balloons ("tetroons") released in the San Francisco Bay Area during the summers of 1966 and 1967. Approximately 100 tetroons were released and most were successfully tracked automatically with M-33 radar systems. Positions were recorded on tape at ten-second intervals. Plots of the horizontal trajectories of all successfully tracked balloons appear in chronological order. In many instances, the vertical trajectories and the horizontal speeds as functions of time and/or horizontal distance are also shown; these follow groups of plots of horizontal trajectories. Author

N69-10454*# Pittsburgh Univ., Pa. Space Research Coordination Center.
POSITIVE ION REACTIONS
Wade L. Fite 17 May 1968 37 p refs
(Grant NsG-416)
(NASA-CR-97601; SRCC-74) Avail: CFSTI CSCL 04A

An overview is presented of the principal laboratory methods used to obtain thermal energy data on total cross sections and reaction rate coefficients for ion-neutral reactions. Modifications of these methods and alternative methods are summarized that can be used to assess the effects of increased kinetic energy and reactants in excited states; and contributions of higher energy experiments are discussed. Only reactions involving positive ions are considered in this review which covers energy processes of interest to aeronomy. Details are included for mass spectrometric and ion cyclotron resonance methods used at energies of 0.008 to 0.05 eV; secondary ions and pulsed sources in mass spectrometers, drift tubes, and merging beams used in energies between 0.025 to 10 eV; and double mass spectrometric and crossed beam methods for medium to high energy studies. M.W.R.

N69-10457# Woods Hole Oceanographic Institution, Mass.
AIRCRAFT METEOROLOGICAL DATA FROM THE LINE ISLANDS EXPERIMENT
Margaret A. Chaffee and Andrew F. Bunker Apr. 1968 68 p refs /its Reference No. 68-25
(Grant NSF GA-821)
Avail: Issuing Activity

The Line Island Experiment was an intensive program of meteorological observations made within the Intertropical Convergence Zone (ITC Zone) in the Pacific to supplement photographic coverage by the Advanced Technological Satellite-1. The specially instrumented C-54Q aircraft made observational flights in this Zone on 12 days during April–May 1967. The reduced data collected on these flights includes cloud cross-sections, short wavelength radiation sections, cloud echo maps from radar films and potential temperature and mixing ratio sections from dropsonde data. Author

N69-10486*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ELECTRON MEASUREMENTS BEARING ON THE ENERGY AND PARTICLE BALANCE OF THE UPPER F-REGION
L. H. Brace, H. G. Mayr, and J. A. Findlay Sep. 1968 27 p refs
(NASA-TM-X-63382; X-621-68-383) Avail: CFSTI 04A

Electron temperature and density profiles measured between 120 and 630 kilometers at midday at Wallops Island on March 2, 1966 are presented and interpreted. The temperature profile exhibits a strong positive gradient (24°/km) below 150 kilometers followed by a smooth transition to a much smaller positive gradient (1.5°/km) above 300 kilometers. Between 300 and 400 kilometers, the electron density decreases with a scale height of about 100 kilometers, which is significantly lower than the diffusive equilibrium scale height for the observed temperatures. Furthermore, the scale height more than doubles between 400 and 500 kilometers. This change in scale height in a region where the mean ion mass and the electron temperature are nearly constant is also inconsistent with diffusive equilibrium and suggests that some dynamic process was occurring at the time of the flight. A simultaneous solution of the particle and energy continuity equations for the F-region is carried out with the aid of inputs and boundary conditions from measurements of neutral composition, neutral gas temperature, and ion composition from the same vehicle. This analysis permits us to conclude that the upper F-region was not in diffusive equilibrium between 300 and 500 kilometers and that the low plasma scale height at these altitudes was consistent with either a neutral atmospheric wind or a rapid temporal variation in O^+. Author

N69-10483# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
DETERMINATION OF C LAYER ELECTRON DENSITIES FROM RADIO WAVE ABSORPTION MEASUREMENTS
J. M. Musser 20 Dec. 1968 89 p refs
(Grant NSF GA-1456)
(SR-330) Avail: Issuing Activity

Techniques for determining electron densities in the C layer from the resultant nondeviative absorption on oblique incidence radio waves are described. A third order polynomial is assumed to represent the electron density and its ability to reproduce test C layers is examined. This is then used with measured absorption data to determine the C layer electron density. Unsatisfactory results with the above method requires the use of a model electron density profile which shape is similar to that measured by rocket probes. The result is a profile with peak density similar to that derived from other ground based measurements. Author

N69-10488*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DATA ANALYSES IN CONNECTION WITH THE NATIONAL GEODETIC SATELLITE PROGRAM
C. A. Lundquist May 1967 29 p refs
(Contract NSR-09-015-018)
(NASA-CR-97608; QPR-12; Rept.-805-7) Avail: CFSTI CSCL 08E

Station coordinates in the SAO system are derived for several stations in the SECOR, GRARR, and TRANET Doppler networks, and for miscellaneous optical stations. The dynamical method used in approaching the problem is described. The geodetic satellite Geos 1 was found to be very successful in the determination of the locations of many new stations in the SAO C6 system. Also included are tabulations on the status of normal and select observation files used for geodetic studies: the simultaneous observations chosen to extend the SAO geometric network to the new SAO stations in Argentina, Brazil, Ethiopia, and Greece; and the 1967 cooperative French laser observations. M.G.J.

N69-10492*# Rocketdyne, Canoga Park, Calif. Research Dept.
APPLICATION OF BIOGEOCHEMISTRY TO MINERAL PROSPECTING A Survey
Washington NASA 1968 135 p refs
(Contract NAS8-5604)
(NASA-SP-5056) Avail: CFSTI CSCL 08G

The application of a combination of disciplines into the hybrid science termed biogeochemistry has gained momentum in recent decades, bringing the benefit of research into the overlapping areas of geology, biology, and chemistry. This report coalesces these technologies in a coherent interrelationship for application to mineral prospecting. Theoretical concepts are presented, including the geochemical cycle through which chemical elements pass in the process of becoming plant nutrients, the physiological requirements necessary for plant growth, and the interrelationship of these two bodies of knowledge which are directly applicable to the solution for the problem of prospecting. Author

N69-10499# Groupe de Recherches Ionospheriques, Paris (France).
IONOSPHERIC DATA FROM GRACHY, OCTOBER–DECEMBER 1966 [DONNEES IONOSPHERIQUES DE GARCHY, OCTOBRE–DECEMBRE 1966]
Dec. 1966 75 p In FRENCH
Avail: Issuing Activity

Ionospheric characteristics and median values are presented in tabulated form. Transl. by M.G.J.

N69-10500# Groupe de Recherches Ionospheriques, Paris (France).
IONOSPHERIC DATA FROM GARCHY, JANUARY–MARCH 1967 [DONNEES IONOSPHERIQUES DE GARCHY, JANVIER–MARS 1967]
R. P. Lejay 1967 79 p In FRENCH
Avail: CFSTI

For abstract, see N69-10499

N69-10501# Groupe de Recherches Ionospheriques, Issy-Les-Moulineaux (France).
IONOSPHERIC DATA OF GARCHY, APRIL–JUNE 1967 [DONNEES IONOSPHERIQUES DE GARCHY, AVRIL–JUIN 1967]
R. P. Lejay Jun. 1967 74 p In FRENCH
Avail: Issuing Activity

For abstract, see N69-10499

N69-10502# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).
IONOSPHERIC DATA OF GARCHY, JULY–SEPTEMBER 1967 [DONNEES IONOSPHERIQUES DE GARCHY, JUILLET–SEPTEMBRE 1967]
R. P. Lejay Sep. 1967 74 p In FRENCH
Avail: Issuing Activity

For abstract, see N69-10499

N69-10505# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
DETERMINATION OF THE COMPLEX INDEX OF REFRACTION OF ROCKS AND MINERALS
W. G. Egan and J. F. Becker Nov. 1968 12 p refs Presented at the Ann. Meeting of the Optical Soc. of Am., Pittsburgh, 9–12 Oct. 1968
(RM-428J) Avail: Issuing Activity

Optical constants were determined for a basalt and a limonite, considered reasonably representative of lunar and Martian surfaces, by using polarization type reflectance measurements. It was assumed that there was relatively small absorption by the minerals themselves, and the principal angle was assumed equal to the quasi-polarizing angle of semiconductors or the equivalent of the Brewster angle for dielectrics. The index of refraction was thus obtained, and the attenuation index was deduced for the higher absorptivity materials from the azimuth of the amplitudes. At wavelengths from 0.35 to 1.0 μ, the basalt exhibited constant index of

refraction and attenuation coefficient values, whereas the ilmonite showed an increase in index of refraction and in absorption toward shorter wavelengths. M.W.R.

N69-10508*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW ENERGY ELECTRON PRECIPITATION PATTERN AT HIGH LATITUDES
R. A. Hoffman Nov. 1968 29 p refs
(NASA-TM-X-63385; X-612-68-416) Avail: CFSTI CSCL 04A

From a consideration of all data available from satellite-borne detectors measuring low energy electrons, an electron precipitation pattern at very high latitudes for periods of relatively low magnetic activity is formulated. From midnight through the dawn side until at least local noon, auroral oval latitudes are characterized by a broad, structureless precipitation, with the electrons having a hard energy spectrum and a pitch angle distribution which is almost isotropic over the upper hemisphere. Poleward of this region, although somewhat overlapping and apparently at all local times, there is a region of bursts or spikes of electrons with usually a very soft energy spectrum. At pre-midnight times highly structured electron precipitation occurs with rapidly varying spectrums. Very little precipitation is observed near the magnetic pole. Author

N69-10510# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
UNDULANCE AND TURBULENCE IN STABLY STRATIFIED MEDIA
Yih-Ho Pao Aug. 1968 30 p refs Presented at the Symp. on Clear Air Turbulence and its Detection, Seattle, 14–16 Aug. 1968
(DI-82-0742) Avail: Issuing Activity

The mechanisms for generating turbulence in stably stratified media are linked with the mechanisms for generating vorticity, shear, and stratification. The turbulence induced by st ble stratification is evidenced in two experimental results: turbulent rotors in the lee of a barrier in a stably stratified fluid, and the breaking of traveling internal waves on a sloping surface. The ability of stable stratification to generate turbulence is also indicated from an exact solution for an inviscid stably stratified flow past a barrier. The structure of undulance and turbulence in stably stratified media is investigated in a stratified salt water towing tank, with schlieren photographs, quartz coated hot-film probes, and single electrode conductivity probes. The schlieren photographs show clearly the collapse of a turbulent wake and the attenuation of turbulence by stable stratification. From the measured auto correlations and spectra, the combined wave–turbulence behavior is clearly shown, and the turbulence is strongly anisotropic. Author

N69-10526# Royal Aircraft Establishment, Farnborough (England).
VARIATIONS IN AIR DENSITY AT A HEIGHT OF 480 km, FROM THE ORBIT OF MIDAS 2
D. G. King-Hele and Janice Hingston Dec. 1967 23 p refs
(RAE-TR-67321) Avail: CFSTI

The orbit of the satellite Midas 2 is analysed to determine the variation in air density at a height of 480 km between November 1965 and November 1967. After correction for variations in solar activity, the density exhibits a semiannual variation with the maximum monthly values (April and October) exceeding the minimum (January and June) by a factor of 2.1. This variation is appreciably greater than indicated by existing model atmospheres. The form of the variations is similar to that obtained (up to January 1967) from Echo 2 at 1130 km and (up to June 1967) from Secor 6 at 191 km. The results suggest that the last three troughs in the semiannual variation (in mid-1966, early 1967 and mid-1967) have been double minima, the main January and July minima being accompanied by distinct subsidiary minima in March and May. Author

N69-10563# Denver Research Inst., Colo. Dept. of Physics.
DEPENDENCE OF THE MICROPULSATION PERIODS ON THE SIZE OF THE MAGNETOSPHERE
V. L. Patel and R. N. Hastings [1968] 18 p refs
(Grant NSF GA-889)
(DU-889-6808) Avail: Issuing Activity

IMP-1 and Explorer 12 satellite observations of the magnetopause locations are used to study the relationship between the size of the magnetosphere (R_m) and the geomagnetic micropulsation periods (T). Two methods of analysis have been tried. One method gives useful relationship in the form $T=R_m^n$ where $n=13\cdot1\pm0\cdot8$. Limitations of this result are discussed in determination of R_m from the surface observations of T and suggestions are presented for improvements in future studies. Author

N69-10565*# California Univ., Berkeley. Space Sciences Lab.
RELATION OF ENERGETIC PARTICLES IN THE PLASMA SHEET TO THE AURORAL ZONE
K. A. Anderson Jul. 1968 19 p refs
(Contract NAS-5-9077; Grant NGL-05-003-017)
(NASA-CR-97612) Avail: CFSTI CSCL 04A

A review is presented on the observational evidence for a relationship between plasma and energetic particle phenomena in the geomagnetic tail and precipitation of particles into the auroral zone. The properties of the plasma and energetic particles in the geomagnetic tail are summarized, along with the properties of the particles accelerated in the plasma sheet. Figures are included to show (1) the spatial extent of the plasma sheet as determined by Vela and OGO spacecraft; (2) examples of energetic electron fluxes in the plasma sheet 60 R_e into the tail; and (3) comparisons of particle fluxes observed in the geomagnetic tail with riometer records, and of particle fluxes 60 R_e into the magnetotail with ground level measurements. It is pointed out that electron precipitation into the auroral zone during sub-storms shows the same temporal behavior as island fluxes, and that the peak flux of plasma sheet acceleration events decreases with radial distance. M.G.J.

N69-10582# National Environmental Satellite Center, Washington, D. C.
MESO-SCALE ARCHIVE AND PRODUCTS OF DIGITIZED VIDEO DATA FROM ESSA SATELLITES
Arthur L. Booth and V. Ray Taylor Oct. 1968 30 p refs
(NESCTM-9) Avail: CFSTI

Data received from the optical sensors of the ESSA satellites (video data) are digitized and various products produced. The mode of processing described here is of less than full scale resolution, hence is termed meso-scale. The meso-scale archival data tape is described. Computer derived products of the meso-scale archive are shown and discussed. Author

N69-10586#, Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia). Dept. of National Development.
THE GEOLOGY OF THE CARNARVON BASIN, WESTERN AUSTRALIA: PART 3: POST-PERMIAN STRATIGRAPHY; STRUCTURE; ECONOMIC GEOLOGY
M. A. Condon 1968 74 p refs Bull. No. 77
Avail: CFSTI

A period of uplift and erosion followed the Permian regression. Triassic sediments were deposited only in a small area and Jurassic in a slightly larger area in the northwest of the basin and in a small area in the south. The next main sedimentation occurred in the Lower Cretaceous, when a major transgression occurred and a basal sandstone and mainly fine grained terrigenous and organic sediments were deposited. These were followed after a small hiatus by mainly carbonate sediments of Upper Cretaceous and Tertiary age. The Carnarvon Basin is a compound basin. It is divided meridionally by a basement ridge (mainly subsurface) and on either

side of this ridge are several smaller basins that developed at different times from late Precambrian to Cretaceous. The main structural style results from the basin downwarps rather than from major tangential compression. The basin is regarded as having a good potential for petroleum—the Barrow Island oil and gas field is at its northern end. The underground water potential is outlined and an indication given of the occurrence of barite, bauxite, bentonite, clays, glauconite, gypsum, limestone, and radiolarite. Author

N69-10650# Iowa State Univ. of Science and Technology, Ames.
ABSOLUTE ABUNDANCE OF THE TITANIUM ISOTOPES IN NATURE
Harold Arthur Belsheim (Ph.D. Thesis) May 1968 91 p refs
(Contract W-7405-ENG-82)
(IS-T-217) Avail: CFSTI

Abundances in 20 titanium ores and minerals of worldwide occurrence and in the TiO_2 used in the chemical determination of the atomic weight of titanium were compared with the abundances in a reference sample of TiO_2. No variations were found. This means that unknown sample ratios divided by reference sample ratios (ratios with respect to ^{48}Ti and measured on the same day) are 1.000 X the following standard deviations: ^{46}Ti–0.0048; ^{47}Ti–0.0030; ^{49}Ti–0.0030; and, ^{50}Ti–0.0051. The mass spectrometer was calibrated by analyzing mixtures of separate titanium isotopes. From the calibration were obtained the absolute abundances in nature. The latter values in atomic per cent are: ^{46}Ti = 8.24 ± 0.45; ^{47}Ti = 7.44 ± 0.22; ^{48}Ti = 73.71 ± 0.48; ^{49}Ti = 5.43 ± 0.16; and, ^{50}Ti = 5.18 ± 0.31. The calibration gave the preponderant contribution to the error. Author (NSA)

N69-10663*# Volt Information Sciences, Inc., Washington, D. C.
PHOTOGRAPH OF THE EARTH FROM AIS ZOND-5
Greenbelt, Md. NASA. Goddard Space Flight Center 29 Oct. 1968 4 p Transl. into ENGLISH from Pravda (Moscow), 26 Oct. 1968
(Contract NAS5-12487)
(NASA-CR-97577; ST-PR-LPS-10767) Avail: CFSTI CSCL 04A

Spacecraft Zond 5 photographs of the earth from outer space during the final portion of the trajectory show the well defined outlines of regions around the Mediterranean, Black, Caspian, and Aral seas; Arabian Peninsula; Iranian Highlands; and the greater part of Africa. A considerable part of the Earth's surface is hidden by clouds. G.G.

N69-10728*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ION, ELECTRON AND NEUTRAL TEMPERATURES DERIVED FROM ION COMPOSITION DISTRIBUTION
B. C. Narasinga Rao May 1968 12 p refs
(NASA-TM-X-63380; X-615-68-184) Avail: CFSTI CSCL 04A

The positive ion mass spectrometer aboard the Argo D-4 rocket was used to measure the ionic constituents O^+, N^+, H^+, He^+, NO^+, O^+_2. The measurements showed O^+ as the major constituent throughout the altitude range of 200 to 630 km. Based on diffusive equilibrium, an equation is given for determining the distribution of an ionic species X^+ in an ion mixture having a mean ionic mass. Using this equation, a formula is obtained to derive ion temperature (T_i) from the height gradient of the ratio of $n(X^+_1)$ and $n(X^+_2)$ if both of them are in diffusive equilibrium. The values of T_i and its height variations are used to derive the electron temperature (T_e), and an equation is presented for determining the geopotential scale height of the electron density distribution under diffusive equilibrium. Ways of obtaining the neutral temperature (T_n) are mathematically defined. M.G.J.

N69-10747# Florida Inst. of Tech., Melbourne. Lab. for Environmental and Solar Studies.
RELATIONSHIP BETWEEN GEOMAGNETIC STORMS AND TROUGH DEVELOPMENT
David D. Woodbridge and James A. Lasater [1967] 29 p refs
(Grant NSF GU-1665)
(TR-2) Avail: Issuing Activity

Comparative data on the relationship between geomagnetic activity and the subsequent development of upper air circulation patterns during solar activity maximum and solar activity minimum are reported. Evaluated are results obtained from a study (1956) to correlate the changes in the circulation patterns near the tropopause and the occurrence of geomagnetic storms at a period of time near maximum solar activity, and results obtained from a study (1965) of the occurrence of a similar correlation between geomagnetic storms and the development of low pressure troughs in the upper atmosphere at a period of time near a solar sunspot minimum. Emphasized are results obtained from the latter study. Results indicate that (1) the observed relationship between geomagnetic activity and the development of troughs at the 300 mb level near solar activity during the 1956 study may also hold throughout the entire solar cycle; (2) there is a time lag of effect of geomagnetic activity on the circulation periods of the upper atmosphere as a function of depth into the atmosphere; and (3) there is an apparent twelve or thirteen day periodicity in the oscillation of the earth's atmosphere, and troughs that occur after a periodic 12 to 13 day geomagnetic disturbance appear to develop into deeper and more sharply defined systems. S.C.W.

N69-10810* Barringer Research, Ltd., Rexdale (Ontario).
RESULTS OF AIRBORNE SURVEY OF NO_2 AND SO_2 OVER LOS ANGELES BASIN
Sep. 1968 133 p Prepared for NASA and US Geol. Surv.
(Contract NAS9-7958)
(NASA-CR-92376; TR-68-68) Avail: CFSTI CSCL 04A

An airborne survey of atmospheric nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) was performed over the Los Angeles Basin including Los Angeles and Riverside Counties. The purpose of the survey was to evaluate a correlation technique as a means of remotely measuring concentrations of atmospheric contaminants. The data were obtained by aircraft flights during the period May 21 through May 24, 1968. This report describes the airborne measurement procedures, the flight lines or survey patterns flown, the meteorological conditions at the time of flight lines or survey patterns flown, the meteorological conditions at the time of flight, the method of data reduction, and the end results. These results are compared with simultaneous ground based measurements provided by Air Pollution Control District stations. Author

N69-10864*# Volt Information Sciences, Inc., Washington, D. C.
ON CORPUSCULAR HEATING OF POLAR IONOSPHERE
P. M. Nagorskiy and B. V. Troitskiy 19 Nov. 1968 7 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 8, no. 5, 1968 p 858–862
(Contract NAS5-12487)
(NASA-CR-97584; ST-PF-AI-10771) Avail: CFSTI CSCL 04A

The energy of precipitating electrons is considered here as a possible source of the heating of polar ionosphere. The energy transfer is materialized by means of plasma waves, which are generated during the beam's flight through the ionosphere. Estimates show that during strong geomagnetic disturbances, the heating of the F2-layer of the ionosphere could be quite substantial. Author

N69-11087# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE ALBEDO OF A MOUNTAIN REGION FROM HELICOPTER OBSERVATIONS

I. P. Belyayeva 3 Jan. 1968 8 p refs Transl. into ENGLISH from Russian Presented at Conf. on Actinometry and Atmospheric Optics, Moscow, Jun. 1963
(AD-675451; FTD-HT-23-1303-67)
Avail: CFSTI

Albedos were measured from helicopters in a Central Asia mountain region in the vicinity of Tashkent, Yangi-Abad, and the Angren plateau. They are made at different times of the year and the results showed that the terrain influenced the albedo along with the snow cover. Comparative figures are given. TAB

N69-11112# Institute of Physical and Chemical Research, Tokyo (Japan).
STUDY OF AGE DATING BY LUTETIUM 176–HAFNIUM 176 METHOD. ON THE SEPARATION OF ZIRCONIUM AND HAFNIUM
Makoto Shima and Sadayo Amano Ibaraki, Japan Japan Atomic Energy Res. Inst. Jun. 1968 9 p refs Transl. into ENGLISH from Rika Gaku Kenkyusho Hokoku (Tokyo), v. 42, no. 3, 1966 p 133–136
(NSJ-tr-119) Avail: CFSTI

For determination of geological ages, various methods have been developed, including potassium–argon, rubidium–strontium, and lead. By way of eliminating the draw-backs to these methods, the Lu–Hf technique was studied. It utilizes the decay of ^{176}Lu to ^{176}Hf and can be applied for dating of minerals containing Lu and Hf. In this method, it is necessary to separate chemically zirconium and hafnium, to determine hafnium and lutetium and to measure ^{176}Hf by a mass-spectrometer. The methods for separation of zirconium and hafnium were investigated. Among the two solvent extraction methods (TBP-hydrochloric acid or TBP-nitric acid system, and TTA-perchloric acid system) and two ion exchange methods (using Dowex-50 and Amberlite IRA-400, respectively), it was found that the ion exchange method using Dowex-50 can separate hafnium so as to be satisfactorily used for the mass-spectrometry. Author (NSA)

N69-11119# Utah Univ., Salt Lake City. Upper Air Research Lab.
ROCKET AND SATELLITE INSTRUMENTATION FOR IONOSPHERIC MEASUREMENTS Final Report, 1 Jan. 1965–31 Dec. 1967
Kay D. Baker, Glenn D. Allred, and David A. Burt May 1968 73 p Supported in part by DASA
(Contract AF 19(628)-4995)
(AD-675154; UU-68-1; AFCRL-68-0270) Avail: CFSTI CSCL 4/1

The report summarizes work performed under contract No. AF19(628)-4995 involving development and utilization of rocket and satellite probes for ionospheric measurements. In this research, particular emphasis has been given to development of RF probe techniques for electron density measurements and simultaneous utilization of these and many other instruments in coordinated measurements of special ionospheric conditions such as aurora, auroral absorption, etc. Other supporting instruments utilized include Langmuir probes, particle and X-ray counters and spectrometers, Lyman-alpha detectors, scintillators, Gerdien condensers, and photometers. Brief discussions of the rocket and satellite systems and the findings from the various launchings are presented with heavy reference to previous reports, papers, and publications. Author (TAB)

N69-11131# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HINDRANCE-STABILITY OF THE TEMPORAL CRITERIA OF PHASE CORRELATION OF THE SEISMIC WAVES [POMEKHOUSTOYCHIVOST' VREMMENYKH KRITERIYEV FAZOVOY KORRELYATSII SEYSMICHESKIKH VOLN]
S. V. Gol'din 6 Nov. 1967 24 p refs Transl. into ENGLISH from Geol. i Geofiz. (USSR), no. 19, 1966 p 103–115
(AD-675279; FTD-HT-23-715-67) Avail: CFSTI CSCL 8/11

The author examines the criteria of the identified segregation of waves, based on the extreme moments of the functions observed. TAB

N69-11143# Ionosphären-Institut Breisach (West Germany).
IONOSPHERE DATA [IONOSPHAREN-DATEN]
Jan. 1967 40 p
Avail: CFSTI

Hourly values and median values for the E and F regions are tabulated for January 1967. Recordings were made at Dapango, Togo, and frequency range of the ionosonde was 1.00 to 20.0 MHz, frequencies. M.W.R.

N69-11289# National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC DATA
Feb. 1967 79 p
(RRC-A141) Avail: Issuing Activity

Ionospheric data for both the E and F regions are tabulated for recordings made by both automatic and manual equipment at eight stations in India during February 1967. These include ordinary wave critical frequencies for the Es, F1, and F2 layers; and ordinary wave top frequency corresponding to the highest frequency at which a continuous trace is observed in the Es region. Minimum virtual heights are given on the ordinary wave branch for the E region and for the lowest and highest F region stratifications. Lowest virtual height of the trace used to give the foEs data is also tabulated. M.W.R.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N69-10017 Nebraska Univ., Lincoln.
A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF A PNEUMATIC ANGULAR RATE SENSOR
Sunars Arnolds Iesalnieks (Ph.D. Thesis) 1968 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-760

The purpose of this investigation was to determine both theoretically and experimentally the operating characteristics of a pneumatic angular rate sensor which has no moving parts other than the fluid passing through it. The sensor consists of two coaxial disks called a pancake separated by a small distance and of two sink tubes. The fluid enters the sensor at the periphery and leaves through the sink tubes. The vortex motion induced by the rotation of the sensor creates a differential pressure at a cylindrical pickoff. The output of the pickoff is in turn used as a feedback to control the rotation of a body to which the sensor is rigidly attached. The boundary layer equations for radial flow in the sensor were solved and the shear stress and velocity expressions were used to determine the theoretical efficiency of the sensor. Dissert. Abstr.

N69-10095 Boston Univ., Mass. Graduate School.
MULTI-BAND AERIAL PHOTOGRAPHY IN GEOLOGICAL ANALYSIS SIMULATING ORBITAL SATELLITE PHOTOGRAPHY OF PLANETARY BODIES

Robert Francis Burke (Ph.D. Thesis) 1967 229 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 67-13260

The purpose of the research work was to determine the feasibility and desirability of employing high altitude, multiband aerial photography in the fields of topographic mapping and geologic reconnaissance. Multi-band photography as defined in this paper is the technique of using more than one aerial camera and a varied set of films and filter combinations. For this work six cameras were used simultaneously; three with black and white panchromatic film filtered blue, red, and green respectively; one with infrared film filtered for the near infrared; one with color film; and one with infrared color film. The camera systems were flown in a high altitude Cessna 180 aircraft over three areas. The applicability of very small scale multi-band photography to geologic reconnaissance was demonstrated by the study. The distinct advantages of the color integration techniques are also shown. Dissert. Abstr.

N69-10163*# GCA Technology Div., GCA Corp., Bedford, Mass.
AEROMETRY INSTRUMENTATION STUDY Final Report
H. Geary, P. Lilienfield, G. Ohring, and W. Shenk Sep. 1968 328 p refs Prepared for JPL
(Contract NAS7-100; JPL-951954)
(NASA-CR-97468; GCA-TR-68-12-G) Avail: CFSTI CSCL 14B

Possible observational techniques and instrument types for the measurement of meteorological parameters in the atmospheres of Mars and Venus are described. The meteorological parameters considered are atmospheric temperature, pressure, density, wind velocity, water vapor content, and particulate suspensions. A wide range of techniques and instruments are included since the purpose of the study was not to select instrumentation for a particular mission but rather to provide information on all conceivable instrumentation for such measurements. The emphasis is on in-situ observing instruments although information is also provided on remote sensing (from orbiters or flybys) techniques. The information provided includes a discussion of the scientific basis of each measurement technique, a description of the instrument and its operation, procedures for the interpretation of the measurement, and details concerning instrument characteristics, instrument output, payload integration parameters, and the state of development of the instrument. Author

N69-10251# Joint Publications Research Service, Washington, D. C.
COLLECTION OF ARTICLES ON INSTRUMENTS FOR STUDYING UPPER ATMOSPHERE
22 Oct. 1968 147 p refs Transl. into ENGLISH of Tr. Tsentr. Aerolog. Observ. (Moscow), no. 77, 1967
(JPRS-46726) Avail: CFSTI

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1. SOME RESULTS FROM A NEW METHOD FOR MEASURING TEMPERATURE IN THE HIGH ATMOSPHERIC LAYERS WITH MICROTHERMORESISTORS L. K. Bulanova, G. A. Kodin, S. P. Perov, and V. Ya. Rusina p 1–19 refs (See N69-10252 01-14)

2. INSTRUMENTS AND METHODS FOR DETERMINING TEMPERATURE, PRESSURE AND DENSITY IN THE UPPER LAYERS OF THE ATMOSPHERE V. M. Bederov, Ye. A. Besyadovskiy, I. N. Ivanova, G. A. Kokin, and A. S. Ozerova p 20–27 refs (See N69-10253 01-14)

3. BOUNDARY CONDITIONS IN THE THERMAL EFFUSION PROBLEM G. A. Kokin and L. A. Udonova p 28–36 refs (See N69-10254 01-12)

4. MEASUREMENTS OF THE PRESSURE COEFFICIENTS FOR PITOT TUBES IN SUPERSONIC FLOWS S. P. Perov p 37–41 refs (See N69-10255 01-14)

5. MKh-5401 SMALL TIME-OF-FLIGHT MASS SPECTROMETER G. N. Kudryavtsev, G. N. Levina, G. M. Martynkevich, L. N. Ozerov, V. A. Pavlenko, et al p 42–50 refs (See N69-10256 01-14)

6. INSTRUMENTS FOR MEASURING PARTIAL CONCENTRATIONS, TEMPERATURES AND PRESSURES IN THE UPPER ATMOSPHERE E. D. Byuro, G. V. Malyarova, and G. M. Martynkevich p 51–57 refs (See N69-10257 01-14)

7. RATES OF MASS SPECTRUM ANALYSIS OF COMPOSITION OF THE UPPER ATMOSPHERE AND MEASUREMENT ERRORS G. M. Martynkevich p 58–66 refs (See N69-10258 01-14)

8. INSTRUMENTS FOR MEASURING TEMPERATURE AND PARTIAL DENSITY OF MOLECULAR NITROGEN IN THE UPPER ATMOSPHERE A. P. Zhukov, N. A. Sokova, and A. F. Chizhov p 67–71 refs (See N69-10259 01-14)

9. INSTRUMENTS FOR REGISTERING CORPUSCULAR RADIATION IN THE UPPER ATMOSPHERE V. F. Tulinov p 72–78 refs (See N69-10260 01-14)

10. ALLOWANCE FOR INERTIAL ERRORS DURING MEASUREMENT OF THE WIND PROFILE BY THE RADAR METHOD S. V. Pakhomov p 79–87 refs (See N69-10261 01-14)

11. USE OF LASER RADAR FOR INVESTIGATING ATMOSPHERIC PROPERTIES O. K. Kostko p 88–110 refs (See N69-10262 01-16)

12. RADIO SYSTEM FOR TRANSMITTING AND REGISTERING TELEMETRIC AND RANGING DATA FOR SMALL METEOROLOGICAL ROCKETS V. I. Yermakov p 111–131 refs (See N69-10263 01-07)

N69-10252# Joint Publications Research Service, Washington, D. C.
SOME RESULTS FROM A NEW METHOD FOR MEASURING TEMPERATURE IN THE HIGH ATMOSPHERIC LAYERS WITH MICROTHERMORESISTORS
L. K. Bulanova, G. A. Kokin, S. P. Perov, and V. Ya. Rusina *In its* Collection of Articles on Instr. for Studying Upper Atmosphere 22 Oct. 1968 p 1–19 refs (See N69-10251 01-14)
Avail: CFSTI

A method is described for measuring temperature in the high layers of the atmosphere by use of bead microthermoresistors carried by a meteorological rocket. Details are given on laboratory experiments for determining the thermophysical and aerodynamic characteristics of the microthermoresistors, and the results of these experiments are presented. Author

N69-10253# Joint Publications Research Service, Washington, D. C.
INSTRUMENTS AND METHOD FOR DETERMINING TEMPERATURE, PRESSURE AND DENSITY IN THE UPPER LAYERS OF THE ATMOSPHERE
V. M. Bederov, Ye. A. Besyadovskiy, I. N. Ivanova, G. A. Kokin, and A. S. Ozerova *In its* Collection of Articles on Instr. for Studying Upper Atmosphere 22 Oct. 1968 p 20–27 refs (See N69-10251 01-14)
Avail: CFSTI

A concise description is presented on a group of instruments designed for measuring temperature, pressure, and density in the high layers of the atmosphere. Basic expressions are given relating the parameters directly measured by the instruments and the parameters of the free atmosphere. Author

N69-10255# Joint Publications Research Service, Washington, D. C.
MEASUREMENTS OF THE PRESSURE COEFFICIENTS FOR PITOT TUBES IN SUPERSONIC FLOWS

S. P. Perov *In its* Collection of Articles on Instr. for Studying Upper Atmosphere 22 Oct. 1968 p 37–41 refs (See N69-10251 01-14)
Avail: CFSTI

Some results are presented of an experimental study of total-pressure (pitot) tubes in supersonic flows of a rarefied gas. Author

N69-10256# Joint Publications Research Service, Washington, D. C.
MKH-5401 SMALL TIME-OF-FLIGHT MASS SPECTROMETER
G. N. Kudryavtsev, G. N. Levina, C. M. Martynkevich, L. N. Ozerov, V. A. Pavlenko et al *In its* Collection of Articles on Instr. for Studying Upper Atmosphere 22 Oct. 1968 p 42–50 refs (See N69-10251 01-14)
Avail: CFSTI

Details are given on the design and circuitry for a small time-of-flight mass spectrometer designed for investigating the neutral composition of the upper layers of the atmosphere in the range 1–100 amu. Author

N69-10257# Joint Publications Research Service, Washington, D. C.
INSTRUMENTS FOR MEASURING PARTIAL CONCENTRATIONS, TEMPERATURES AND PRESSURES IN THE UPPER ATMOSPHERE
E. D. Byuro, G. V. Malyarova, and G. M. Martynkevich *In its* Collection of Articles on Instr. for Studying Upper Atmosphere 22 Oct. 1968 p 51–57 refs (See N69-10251 01-14)
Avail: CFSTI

Brief descriptions are presented on a successfully tested group of instruments for measuring partial concentrations, temperatures, pressures, and other parameters in the upper atmosphere. This group includes two radio-frequency total-head radio-frequency mass spectrometers with intake tubes of different length, two ionization manometers (total-head and static), and auxiliary instruments. Author

N69-10258# Joint Publications Research Service, Washington, D. C.
RATES OF MASS SPECTRUM ANALYSIS OF COMPOSITION OF THE UPPER ATMOSPHERE AND MEASUREMENT ERRORS
G. M. Martynkevich *In its* Collection of Articles on Instr. for Studying Upper Atmosphere 22 Oct. 1968 p 58–66 refs (See N69-10251 01-14)
Avail: CFSTI

An analysis is presented on the errors in measurements of partial concentrations caused by the slow rate of mass spectrum analysis of the upper atmosphere by the stationary flight sensitivities method. It is shown that in some cases slow rates can lead to errors up to 100% or more. This circumstance can at least in part explain the discrepancies in densities measured by direct instrumental methods and computed from the deceleration of artificial earth satellites. Ways to increase the analysis rate are described. Author

N69-10259# Joint Publications Research Service, Washington, D. C.
INSTRUMENTS FOR MEASURING TEMPERATURE AND PARTIAL DENSITY OF MOLECULAR NITROGEN IN THE UPPER ATMOSPHERE
A. P. Zhukov, N. A. Sokova, and A. F. Chizhov *In its* Collection of Articles on Instr. for Studying Upper Atmosphere 22 Oct. 1968 p 67–71 refs (See N69-10251 01-14)
Avail: CFSTI

Apparatus is described in which two omegatron mass spectrometers are used for measuring temperature and density of N_2 in the upper atmosphere. Author

N69-10260# Joint Publications Research Service, Washington, D. C.
INSTRUMENTS FOR REGISTERING CORPUSCULAR RADIATION IN THE UPPER ATMOSPHERE
V. F. Tulinov *In its* Collection of Articles on Instr. for Studying Upper Atmosphere 22 Oct. 1968 p 72–78 refs (See N69-10251 01-14)
Avail: CFSTI

Details are given on instruments for registering corpuscular radiation (of an electromagnetic nature) which are carried by meteorological rockets. The preliminary results of an in-flight experiment are described. Author

N69-10261# Joint Publications Research Service, Washington, D. C.
ALLOWANCE FOR INERTIAL ERRORS DURING MEASUREMENT OF THE WIND PROFILE BY THE RADAR METHOD
S. V. Pakhomov *In its* Collection of Articles on Instr. for Studying Upper Atmosphere 22 Oct. 1968 p 79–87 refs (See N69-10251 01-14)
Avail: CFSTI

Consideration is given to the problem of the distortion of the wind profile due to the inertia of a target entrained by an air current. On the basis of analysis of a differential equation for nonsteady translational motion of a target, it was possible to find a correction which must be introduced into the determined wind velocity profile. Author

N69-10290# Aeronautical Research Labs., Melbourne (Australia).
AN AUTOMATIC MULTI-POINT TEMPERATURE RECORDER
S. G. Kerr May 1968 16 p
(ARL/ME-296) Avail: CFSTI

An X–Y recorder was modified to enable 105 separate graphs of temperature against time to be plotted on one chart directly from thermocouples. Except for daily change of the nine-foot long chart, the plotter operated automatically during each 24-hour cycle. Author

N69-10325# National Research Council of Canada, Ottawa (Ontario).
MEASUREMENT OF DEAD TIMES BY THE METHOD OF COINCIDENCES
C. E. Granados, M. A. Vigon, and F. Verdeguer 1968 9 p refs Transl. into ENGLISH from Anales Real Soc. Espan. Fis. Quim., Ser. A (Madrid), v. 63, no. 5–6, 1967 p 155–159
(NRC-TT-1337) Avail: CFSTI

The correction formula for a very particular case of coincidence counting with different non-extending dead times in the two detector channels is derived. This formula provides a simple and accurate general method for measuring non-extending dead times. Author

N69-10401 Virginia Polytechnic Inst., Blacksburg.
ON THE ACCURACY OF MEASURING TRANSIENT SURFACE TEMPERATURES WITH EMBEDDED THERMOCOUPLES
Nicholas Howard dee Champs (Ph.D. Thesis) 1967 210 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-2040

The investigation presents a practical method of installing an embedded sheathed thermocouple for the purpose of measuring

transient surface temperatures. The theory of two semi-infinite solids being brought instantaneously into contact to yield a known interface temperature was then used to obtain a thermal boundary condition at the surface. A mathematical model of the thermocouple installation was constructed which included not only the thermocouple itself, but a region of bulk material around it, as well as a region of the semi-infinite solid which was in contact with the surface. Physical parameters, indicative of the actual thermocouple installation, were used in the mathematical model and numerical results were obtained which gave the transient temperature distribution in and around the thermocouple. The transient junction temperature of the mathematical model was compared with the response of the actual experimental thermocouple for similar conditions. The mathematical results obtained agreed closely with the experimental results. Dissert. Abstr.

N69-10518# Centro Informazioni Studi Esperienze, Milan (Italy).
STABILIZATION OF A SAMPLING OSCILLOGRAPH BY WAVE FORM MEASUREMENTS [STABILIZZAZIONE DI UN OSCILLOGRAFO A CAMPIONI PER MISURE DI FORME D'ONDA]
C. Cottini, E. Gatti, G. Lepre, and V. Svelto 1968 22 p refs In ITALIAN; ENGLISH summary
(Contract EURATOM-186-66-1 1SPI)
(EUR-3947i) Avail: CFSTI

A method is described for stabilizing the gain and drift of a sampling oscillograph. The method is used in the accurate measurement of fast wave forms, such as those originating from scintillation detectors. The method has been used, in particular, for the measurement of current impulses produced by scintillation detectors following excitation by various types of radiation, such as neutron and gamma radiation. Such results are used in the designing of even discriminators. Author

N69-10523# Aeronautical Research Labs., Melbourne (Australia).
GROUND STATION EQUIPMENT FOR DECODING THE RECORDINGS OF A FLIGHT RECORDER
K. F. Fraser Jan. 1968 53 p refs
(ARL/Inst.-26) Avail: Issuing Activity

Ground station equipment has been developed for decoding the information recorded on magnetic wire during aircraft flight. The composite signal to be decoded consists of a time multiplexed flight data signal which is frequency multiplexed with speech. Details of circuit techniques and an example of an actual flight recording decoded using this equipment are given. Author

N69-10532# Advisory Group for Aerospace Research and Development, Paris (France).
FLIGHT TEST INSTRUMENTATION
M. A. Perry, ed. (SE Labs. (Eng.) Ltd., Feltham, Engl) 1967 443 p refs Presented at the 30th Meeting of the AGARD Flight Mechanics Panel, Montreal, 30 May–1 Jun. 1967
(AGARD-CP-32) Avail: CFSTI

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1. FLIGHT TEST INSTRUMENTATION—THE USER'S REQUIREMENTS M. L. Henney (Brit. Aircraft Corp., Preston, Engl.) p 1–18 refs (See N69-10533 01-14)

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3. TEST OBJECTIVES AND APPLICATIONS OF FLIGHT TEST DATA BY THE STRUCTURES ENGINEER S. L. Gugleta (Boeing Co., Wichita, Kans.) p 43–64 (See N69-10535 01-14)

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8. COMPARISON OF SYSTEMS A. Becker, B. Gartung, and H. Meyer (Deut. Forschungsanstalt fur Luft- und Raumfahrt, Brunswick, West Germany) p 133–162 refs (See N69-10540 01-14)

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10. THE APPLICATION OF REGRESSION ANALYSIS TO THE EVALUATION OF INSTRUMENT CALIBRATIONS O. H. Gerlach (Technische Hogeschool, Delft, Neth.) p 175–210 refs (See N69-10542 01-14)

11. SOME CONSIDERATIONS OF THE "PHILOSOPHY" OF THE UTILIZATION OF FLIGHT TEST MEASUREMENTS G. Petit (Centre d'Essais en Vol, Bretigny-Sur-Orge, France) p 211–242 (See N69-10543 01-14)

12. A DATA PROCESSING FACILITY FOR THE XB-70 FLIGHT TEST PROGRAM E. L. Edwards (North Am. Aviation, Inc., Los Angeles, Calif.) p 243–258 (See N69-10544 01-08)

13. STATISTICAL METHODS FOR THE REDUCTION OF DYNAMIC FLIGHT DATA G. J. Born and E. J. Durbin (Princeton Univ.) p 259–298 refs (See N69-10545 01-08)

14. FORCE FEEDBACK INERTIAL INSTRUMENTS I. McLaren (RAE, Bedford, Engl.) p 299–312 (See N69-10546 01-14)

15. DEVELOPMENTS IN RATE GYROSCOPES R. P. G. Collinson and A. R. Essex (Elliott Flight Automation, Ltd., Rochester, Engl.) p 313–334 (See N69-10547 01-14)

16. TEMPERATURE-SENSING TECHNIQUES F. Trenkle and M. Reinhardt (Deut. Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) p 335–372 refs (See N69-10548 01-14)

17. MEASUREMENT OF FLOW SPEED AND FLOW DIRECTION BY AERODYNAMIC PROBES AND VANES W. Wuest (Aerodynamische Versuchsanstalt, Gottingen, West Germany) p 373–426 refs (See N69-10549 01-14)

18. AN AIRSPEED MEASURING SYSTEM FOR HELICOPTERS D. F. Daw (Natl. Res. Council of Canada) p 427–447 refs (See N69-10550 01-14)

N69-10533# British Aircraft Corp., Preston (England).
FLIGHT TEST INSTRUMENTATION: THE USER'S REQUIREMENTS
M. L. Henney *In* AGARD Flight Test Instrumentation 1967 p 1–18 refs (See N69-10532 01-14)
Avail: CFSTI

The role of flight test instrumentation, automated data analysis techniques, and systems and/or flight test engineers in the aircraft flight development process is discussed. Emphasized are inherent problems which accompany improvad efficiency of the flight development process, and which are directly linked with the lack of adequate airborne/automated data analysis and compression techniques. The potential of airborne digital computers and other analysis equipment used in conjunction with the proposed flight test instrumentation system is discussed. S.C.W.

N69-10534# Centre d'Essais en Vol, Bretigny-Sur-Orge (France).
THE FLIGHT PERFORMANCE TESTS OF SUPERSONIC AIRPLANES [LES ESSAIS EN VOL DE PERFORMANCES DES AVIONS SUPERSONIQUES]

J. F. Renaudie *In* AGARD Flight Test Instrumentation 1967 p 19–42 In FRENCH (See N69-10532 01-14)
Avail: CFSTI

How supersonic flights and aircraft differ in their properties from their subsonic counterparts are discussed. New methods for measuring the flight performance of supersonic craft are evolved. The flight pattern of a Concorde craft is depicted and its performance characteristics are charted. Transl. by B.P.

N69-10535# Boeing Co., Wichita, Kans.
TEST OBJECTIVES AND APPLICATIONS OF FLIGHT TEST DATA BY THE STRUCTURES ENGINEER
Stephen L. Guglets *In* AGARD Flight Test Instrumentation 1967 p 43–64 (See N69-10532 01-14)
Avail: CFSTI

The following four types of structural flight tests are discussed in terms of test objectives, physical quantities to be measured, type of record, data accuracy, data reduction, and final format: (1) acoustic environmental survey; (2) vibration environmental survey; (3) flight flutter tests; and (4) flight loads tests. The discussion is generally applicable to any aircraft although many of the figures, examples, and data presented are specifically pertinent to the B-52 heavy bomber. Specific conclusions drawn from the discussion are: (1) the specific instrumentation requirements for each type of test depend on the aircraft to be tested and the number of the physical quantities to be measured; (2) close liaison should be maintained between those responsible for design, flight testing, and data handling; and (3) constant effort must be expended in reducing the elapse time between recording and delivery of final reduced flight test data. S.C.W.

N69-10536# Royal Aircraft Establishment, Bedford (England).
STABILITY AND CONTROL FLIGHT TESTING: SOME OF THE TEST INSTRUMENTATION REQUIREMENTS
R. Rose *In* AGARD Flight Test Instrumentation 1967 p 65–76 (See N69-10532 01-14)
Avail: CFSTI

A flight test engineer's view of instrumentation requirements for stability and control flight testing is presented, and possible future trends in the development of more sophisticated methods of analysis are discussed. In the discussion of instrumentation requirements, the type and accuracy of the quantities required in stability and control flight testing are considered first, followed by discussion on voltage supplies, transducers, recording systems, and readout systems. Typical ranges of quantities essential to stability and control tests include rate of rotation, incidence, sideslip, and angular acceleration. In the overall assessment of the present position and future trends of test instrumentation, it is shown that although the present trend in the analysis of stability and control flight tests is to use more sophisticated methods of analysis in an attempt to extract more data, experience with these methods shows that they cannot produce better results than the more simple methods unless the accuracy of the data acquisition system is improved. It is suggested that the immediate aim should be to improve the overall accuracy to 1%, with a longer term aim of achieving 0.2%. It is suggested that since recording systems (i.e., photographic trace recorders) represent a significant proportion of overall inaccuracies, some better form of recording must be used such as magnetic tape recording systems. Also, it is suggested that telemetry be used as a data acquisition system. S.C.W.

N69-10537# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
SOME PROBLEMS OF DATA ACQUISITION FOR VTOL FLIGHT-TEST DATA ANALYSIS
J. Schaeffler and H. Alscher *In* AGARD Flight Test Instrumentation 1967 p 77–96 refs (See N69-10532 01-14)
Avail: CFSTI

Four basic aspects of instrumentation which must be considered in the design of flight test instrumentation for VTOL aircraft are discussed, and typical examples of problems inherent in VSTOL aircraft flight tests which were observed during the VJ 101 test program are discussed. The four basic aspects considered include: (1) the flight safety aspect; (2) the aspect of comparision of actual flight test results with predictions; (3) the design-guidelines and specification aspect; and (4) the aspect of actual operation. It is shown that main problems are measurement of the direction and magnitude of airspeed over a wider range; measurement of engine dynamics; flow field conditions in inlets and on propellers over a wide range of incidence conditions; the effects of recirculation and jet induced aerodynamics; and measurement of temperature and acoustic fields over large portions of the airframe and the landing site. S.C.W.

N69-10538# Sandia Corp., Albuquerque, N. Mex.
IRIG TELEMETRY STANDARDS
R. Stanton Reynolds *In* AGARD Flight Test Instrumentation 1967 p 97–118 (See N69-10532 01-14)
Avail: CFSTI

IRIG (Inter-Range Instrumentation Group) was primarily formed to assist the Range Commanders in fulfilling the mission of the Ranges, i.e., overcoming problems of instrumentation support and missile flight safety arising with the development of long range missiles which contemplated use of more than one range in testing. In accomplishing its function, IRIG investigates problem areas and studies ways in which to ease the problems. In order to take advantage of large-volume procurement cost advantages, IRIG continually searches for areas where joint procument by several agencies may be effected. Research and development projects are analyzed and areas of existing or probable overlap of effort are identified and eliminated, where possible. As an aid to range operations procedures and to assure that at least minimal facilities are available and compatible from one range to another, standards are prepared by IRIG and, although officially the standards are only recommendations, they have been accepted by the ranges as obligatory, that is, defining a system which the range will make available if it is required. Standards have been generated to cover range timing, telemetry, command destruct systems, frequency management, C-band radars, and many other range functions. One of the most publicized and most familiar of these documents is the telemetry standard which has recently been revised and is in circulation as IRIG Document 106-66, "IRIG Telemetry Standards." Presented is an account of the evolution of this standard. S.C.W.

N69-10539# National Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
SIGNAL CONDITIONING IN FLIGHT-TEST INSTRUMENTATION
A. J. L. Willekens and A. Pool *In* AGARD Flight Test Instrumentation 1967 p 119–132 refs (See N69-10532 01-14)
Avail: CFSTI

A general outline of methods applicable in airborne signal conditioning operations is presented; difficulties involved in obtaining a clear definition of signal conditioning are discussed; and suggestions are given which may lead to a sharper definition of signal conditioning. Signal conditioning operations considered include: linear operations, multiplicative operations, signal conversion, sampling, and filtering. It is shown that the difficulty in obtaining a clear definition of signal conditioning is that the boundaries of what is understood by the words transducer, measuring system, and computer are not well defined. Problems of signal commutation, i.e., the sampling effect which commutation has on the performance on a single channel, are discussed. Examples of techniques for filtering digital signals (sampled) in computers which can be used in airborne flight test equipment are given. Cited is the applicability of on-line filters for digital signals and phase locked fiters for pulse duration modulated signals. S.C.W.

N69-10540# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).
COMPARISON OF SYSTEMS
A. Becker, B. Gartung, and H. Meyer *In* AGARD Flight Test Instrumentation 1967 p 133–162 refs (See N69-10532 01-14)
Avail: CFSTI

Two different comparisions are made of systems popularly used in flight test techniques. In the first analysis, the techniques of onboard data recording (paper recording, magnetic tape recording) and telemetry are assessed. The following factors are cited as being decisive in the choice of the system when planning a test: accuracy; maximum information rate; storage capacity; duration of measurement; range; data processing; guarantee for data reception with respect to system performance; difficulties of installation (size and weight); preparation time of test; versatility; operation and maintenance; guarantee for data reception with respect to loss or damage of the missile or aircraft; and cost of equipment and recording material. In the second analysis, different IRIG-standardized telemetry techniques (i.e., multiplex and radio frequency link) are discussed. Principles of comparision focused on the following: maximum information rate; maximum number of data channels; accuracy; flexibility; utilization of radio frequency power; and utilization of radio frequency bandwidth. S.C.W.

N69-10541# Boeing Co., Seattle, Wash. Commercial Airplane Div.
ECONOMICS OF FLIGHT-TEST DATA SYSTEMS
H. L. Tollisen *In* AGARD Flight Test Instrumentation 1967 p 163–174 (See N69-10532 01-14)
Avail: CFSTI

Economic aspects of a flight test data system which were encountered during the Boeing Company's commercial transport certification program are discussed. Considered is the economic impact of flight test requirements; data requirements; data system design; instrumentation equipment; and personnel. Factors which should be considered in cost control analyses are also outlined. It is concluded that (1) the most important economic factor in a commercial transport certification program is calendar time; (2) since time spent processing data must be kept to a minimum it is economically feasible to implement an automatic tape data system; however, the system is a very expensive, complicated tool designed to do a specific type of job, and in order to be reliable and flexible must have highly qualified people in several key positions; (3) a flight test program is predictable in spite of being experimental in nature and most of the data requirements can be accurately estimated prior to the start of a program; and (4) those requirements that develop during a program, while individually unpredictable, respond well to statistical averaging over the duration of a complete certification program; thus, normal types of business controls can be used effectively. S.C.W.

N69-10542# Technische Hogeschool, Delft (Netherlands).
THE APPLICATION OF REGRESSION ANALYSIS TO THE EVALUATION OF INSTRUMENT CALIBRATIONS
O. H. Gerlach *In* AGARD Flight Test Instrumentation 1967 p 175–210 refs (See N69-10532 01-14)
Avail: CFSTI

The application of regression analysis in the transformation of flight test instrument calibration data into an appropriate analytical expression (the calibration characteristic) suitable for analysis by high speed digital computers is discussed. Basic aspects of the method which have useful applications in deriving instrument calibration characteristics are analyzed, and examples which illustrate the applicability of the method in transforming calibration data of a simple rate-gyro; a high accuracy rate-gyro; a set of three accelerometers; and an airspeed indicator are given. It is concluded that: (1) since it appears to be possible to express the calibration data of an instrument in a calibration characteristic of analytic form, the method of regression analysis can be used to convert calibration data into a polyomial; (2) in cases where calibration data cannot be expressed as a simple polynomial, a suitable mathematical model for calibration data can be constructed, and regression analysis can be used successfully to match the unknown coefficients of the model to the calibration data; and (3) handling calibration data of present-day high accuracy instruments associated with a digital recording system using regression analysis methods proves no more difficult than applying the same techniques to simple less accurate instruments. S.C.W.

N69-10543# Centre d'Essais en vol, Bretigny-Sur-Orge (France).
SOME CONSIDERATIONS OF THE "PHILOSOPHY" OF THE UTILIZATION OF FLIGHT TEST MEASUREMENTS [QUELQUES CONSIDERATIONS SUR LA "PHILOSOPHIE" DE L'EXPLOITATION DES MESURES DANS LES ESSAIS EN VOL]
G. Petit *In* AGARD Flight Test Instrumentation 1967 p 211–242 In FRENCH (See N69-10532 01-14)
Avail: CFSTI

The problems posed by handling, analyzing, and utilizing the myriad of data collected by satellites and supersonic and experimental aircraft are discussed. A technique is proposed for rapid and automatic exploitation of the collected measurements. Flow charts of the various steps involved in the information retrieval are depicted. Transl. by B.P.

N69-10546# Royal Aircraft Establishment, Bedford (England).
FORCE FEEDBACK INERTIAL INSTRUMENTS
I. McLaren *In* AGARD Flight Test Instrumentation 1967 p 299–312 (See N69-10532 01-14)
Avail: CFSTI

The potential of force feedback airborne inertial measuring instruments working on servo principles for flight test applications is discussed. Inertial instruments considered include accelerometers and single-axis gyroscopes. To illustrate the principles of operation of servo instruments, two types of force feedback accelerometers are considered: the pendulous-arm and the rectilinear type. The performance of a commercially available pendulous-arm type of accelerometer under operational conditions encountered in flight is examined; major sources of inaccuracy due to vibrations as saturation errors and rectification errors are analyzed; and design modifications for avoiding special problems of these instruments are suggested. It is concluded that force feedback transducers are potentially capable of realizing accuracies which are one or two orders higher than those of conventional mass spring types; however, these accuracies may not always be physically realizable in practice if high frequency underdamped systems are subjected to oscillatory signals or unwanted noise. S.C.W.

N69-10547# Elliott Flight Automation, Ltd., Rochester (England).
DEVELOPMENTS IN RATE GYROSCOPES
R. P. G. Collinson and A. R. Essex *In* AGARD Flight Test Instrumentation 1967 p 313–334 (See N69-10532 01-14)
Avail: CFSTI

Trends in the development of spring-restrained and electrical force-balance (or force feedback rate) gyroscopes used in flight test instrumentation for measuring angular rate of rotation are discussed. Considered are basic requirements for flight test gyroscopic rate instruments; basic types of rate measuring instruments (i.e., rate gyroscope, so-called laser gyroscope, and single-degree-of-freedom rate gyroscope); general theory; and construction and design features of typical rate gyros, i.e., the spring-restrained, fluid damped, sub-miniature rate gyro and the Elliott electrical force balance monitored rate gyro. Advantages of electrical force-balance rate gyroscopes over the mechanical spring-restrained gyroscopes are

listed. Included is a description of production tested methods used for spring-restrained rate gyros to maintain build standards and ensure adequate functional quality; which are applicable to the force-balance gyro. S.C.W.

N69-10548# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).

TEMPERATURE-SENSING TECHNIQUES

F. Trenkle and M. Reinhardt *In* AGARD Flight Test Instrumentation 1967 p 335-372 refs (See N69-10532 01-14)
Avail: CFSTI

Sensing techniques, i.e., resistance thermometers and thermocouples, used for measuring temperature in aircraft are discussed. Emphasized are inherent problems associated with measuring outside air temperature (i.e., free air) using existing methods of error analysis and correction. Considered are problems arising as a result of temperature position error, probe errors, instrument error, and those problems inherent in measurements of the so-called temperature rise which is an effect on the temperature measurement of media with very high flow velocities. Criteria for use in the selection of probes for measurements of air or gas temperature in a duct; temperature measurement in liquids, and surface temperature measurements are also discussed. Calibration techniques and methods for the evaluation of thermometer errors are detailed, and comparative data on the advantages of resistance sensors over thermocouples and vice versa are analyzed. S.C.W.

N69-10549# Aerodynamische Versuchsanstalt, Gottingen (West Germany).

MEASUREMENT OF FLOW SPEED AND FLOW DIRECTION BY AERODYNAMIC PROBES AND VANES

W. Wuest *In* AGARD Flight Test Instrumentation 1967 p 373-426 refs (See N69-10532 01-14)
Avail: CFSTI

Discussed are operating principles, performance characteristics, specific applications, and trends in the development of (1) pitot probes, (2) static probes, (3) pitot static probes, (4) venturi meters, and (5) flow direction probes which are employed during flight tests to measure flow speed and flow direction. Included is an extensive bibliography which cites 113 foreign and English language publications on aerodynamic probes classifiable under the above headings. S.C.W.

N69-10550# National Research Council of Canada, Ottawa (Ontario).

AN AIRSPEED MEASURING SYSTEM FOR HELICOPTERS

D. F. Daw *In* AGARD Flight Test Instrumentation 1967 p 427-447 refs (See N69-10532 01-14)
Avail: CFSTI

Reported is the development of an airspeed system which gives outputs proportional to longitudinal and lateral components of airspeed, and which can be used on a variable stability helicopter employed as an airborne simulator to investigate problems associated with V/STOL aircraft. The airspeed system uses pitot probes mounted at the tips of both main rotors. The amplitude of the nearly sinusoidal pressure fluctuation measured by these pitot probes is a function of the helicopter airspeed and the phase relationship between this pressure fluctuation and the rotor blade position relative to the helicopter fuselage is the sideslip angle. Principles of operation, component design considerations, and preliminary calibration data are discussed. The system shows promise of more general use on rotorcraft where it is not desirable to install slip rings on the main rotor shaft. In addition to completing tests to determine system accuracy over the flight regime of the simulator, plans are being made to adapt the proposed airspeed system to rotorcraft with articulating rotors and to other applications where it is of interest to measure accurately the components of airspeed close to the hover condition. S.C.W.

N69-10566*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

INTERACTIONS BETWEEN A HYPERSONIC NEUTRAL GAS BEAM AND AN ORIFICED PRESSURE GAUGE MOUNTED IN A SPINNING SATELLITE

G. Newton, P. Silverman, and D. Pelz Oct. 1968 7 p refs Presented at the 6th Rarefied Gas Dyn. Symp., Boston, 1968
(NASA-TM-X-63384; X-621-68-396) Avail: CFSTI CSCL 22B

Based on data from the Explorer 32 atmospheric density experiment, kinetic theory predictions of orificed chamber pressures were compared with pressures measured by orificed, cold cathode, magnetron gauges. The gauges were mounted on the spin equator and maximum pressures were observed when the atmospheric gas particles beamed directly into the gauges. Minimum pressures were observed each time the chamber orifices looked into the rarefaction region behind the satellite. Theoretical predictions of gauge pressures as a function of angle of attack were compared to the measured pressures after the local rarefaction pressures (assumed to be due to desorption) were subtracted from the data. The comparisons were made by taking the ratios of measured pressure to theoretical pressures calculated for a speed ratio of 8 (ratio of satellite speed to most probable thermal speed). The results are plotted versus angle of attack, and the curves appear to be valid for maximum pressures in the range 10^{-8} to 5×10^{-8} torr. It is preliminarily concluded that the theoretical results which assume no specular collisions and no adsorption most nearly describe the measurements. Author

N69-10598# European Atomic Energy Community, Ispra (Italy).

HIGH-TEMPERATURE IN VACUO MICROHARDNESS MACHINE [MACHINE DE MICRODURETE A HAUTE TEMPERATURE SOUS VIDE]

D. Grunspan (SEAVOM, Argenteuil, France), J. J. Jacques (SEAVOM, Argenteuil, France), P. Bonnet, and M. Grin 1968 48 p refs In FRENCH; ENGLISH summary
(EUR-4057f) Avail: CFSTI

An apparatus for testing microhardness is described which operates with a vacuum of $5 \cdot 10^{-6}$ Torr and heats the samples by electron beam. For a circular sample of 25 mm diam at 1000°C, the temperature deviation does not exceed 18° C, and for a 16-mm-diam sample at 700° C it is on the order of 5° C. The heating rate is from 20° to 1000° C in 120 sec, the cooling rate from 1100° to 300° C in 120 sec. Vickers indentations are measured with a special microscope allowing 600X magnification. The penetration rate is measured with a capacitive gage. Up to 100 indentations can be made on one sample, with loads varying from 5 to 1000 g. The application of the apparatus is demonstrated in studies of microhardness curves of four grades of SAP material and with structural transformation studies of a Zr-2.5Nb alloy and a 12% Cr steel after rapid cooling from 1000°C. K.W.

N69-10599# Aeronautical Research Labs., Melbourne, (Australia).

CREEP OF RESISTANCE STRAIN GAUGES AT ELEVATED TEMPERATURES

I. G. Scott May 1968 25 p refs
(ARL/SM-325) Avail: CFSTI

The effect of previous testing on the creep of loaded resistance strain gauges was investigated experimentally. A proposed procedure based on a simple principle of superposition is found to give satisfactory results with the expenditure of much less experimental effort. The results apply to gauges which are considered suitable for use under the present test conditions – in this context the relative creep rarely exceeds one per cent of the applied strain over a period of sixty minutes. The rate of creep was found to vary only slightly with temperature within the limits of operation of the gauge. The effects of changing strain cannot so readily be ignored, e.g. a large and sudden decrease in applied strain can result in a large and possibly excessive increase in the relative creep. However, this can be evaluated and allowance made for the effect. Author

N69-10618# Lund Univ. (Sweden). Machines Elements Div.
ON THE BALL FLOWMETER AND THE BALL VISCOSIMETER
Leif Floberg Stockholm, Swedan Roy. Swed. Acad. of Eng. Sci. 1968 30 p refs Acta Polytech. Scand., Mech. Eng. Ser. No. 38
(ME-38) Avail: Issuing Activity

The case of a ball in a tube filled with liquid is treated theoretically and generalized to apply to both of the two cases, when a ball falls in a tube or when the liquid is moving. The Reynolds lubrication theory is used to determine the conditions in the thin oil films between the ball and the tube wall. Thus the theory holds for small clearances relative to the ball radius. It is shown that the ball rotates with different speeds at different eccentricities. The rotational speed is derived from equilibrium conditions of the ball, which conditions also tell us that all locations of the ball are unstable. Continuity of flow gives the falling velocity of the ball or the oil flow passing the ball. This velocity is a function of the eccentricity. Tests are made with a 2 inch steel ball falling in a tube filled with oil. The accordance between theory and tests is extremely good. Some photos of small cavitation regions are shown. Author

N69-10642# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
ULTRA HIGH VACUUM HIGH ENERGY ELECTRON DIFFRACTION CAMERA
Richard W. Vook and Robert J. Fortanova Jul. 1968 56 p refs Prepared for AEC
(NYO-3715-3) Avail: CFSTI

An ultra high vacuum high energy electron diffraction camera, presently operating up to 50 keV, has been developed. The design, construction, and operational features of this instrument are described in the present report. This instrument was designed for use in studying clean and selectively contaminated surfaces and the nucleation and growth of thin films on these surfaces. Clean surfaces may be obtained in situ in the instrument by heating the sample with an electron beam heater or by argon ion bombardment followed by high temperature annealing. The ability to attain ultra high vacuum is essential in the study of clean surfaces in order to prevent the formation of contamination layers in unreasonably short times. At 10^{-10} Torr, a few hours are required to form a monolayer. Means for producing a controlled atmosphere and measuring its components were incorporated into the instrument. Author (NSA)

N69-10665# Weather Bureau, Silver Spring, Md. Office of Systems Development.
A VISCOUS DAMPED WIND VANE
D. T. Acheson and Herman H. Crouser Oct. 1968 28 p refs
(WBTM-EDL-5) Avail: CFSTI

Mechanical and electrical properties of a viscous damped wind vane are analyzed. The viscous damper is inserted between the vane shaft and the shaft position transducer. This design effectively avoids the 180° ambiguity associated with producing the arithmetic mean of wind direction which is double valued at 0° = 360°, and also provides continuously updated average wind direction automatically. G.G.

N69-10678# Stanford Univ., Calif. Electronics Labs.
A DIGITAL POLARIMETER
Adolph Fejfar Aug. 1968 47 p refs
(Contract NSF-GP-3931)
(SU-SEL-68-065; SR-1) Avail: Issuing Activity

A digital polarimeter which is calibrated for system gain, phase errors, and antenna cross-coupling has been developed. In contrast with similar analog devices, this polarimeter uses a simple receiver system and sophisticated computer processing. The system is being used to study the polarization characteristics of Jovian and solar emissions between 22.0 and 26.3 MHz. The methods developed are directly applicable to a polarimeter operating at any frequency. Author

N69-10679# Atlantic Technology Corp., Somers Point, N. J.
RADAR BRIGHT DISPLAY EQUIPMENT TEST SET GROUP Final Report
Joseph J. Haddox Jun. 1968 25 p refs
(Contract FA-67-WA-1611)
(SRDS-RD-68-22) Avail: Issuing Activity

The test set group was developed to satisfy the need for a test instrument to be used in the maintenance, alignment, calibration, and evaluation of operational Radar Bright Display equipment. This test set group is divided into two major test sets: the Radar Bright Display test set with battery charger and the Radar Servo Calibration test set. One test set group breadboard model was tested and FAA field-evaluated. Five experimental models of the test set and battery charger and three experimental models of the Radar Servo Calibration test set were tested. All units met or exceeded all requirements. Author

N69-10782# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
EVALUATION OF EXPERIMENTAL FLIGHT DATA RECORDERS IN AN AIRCRAFT CRASH ENVIRONMENT Final Report
Paul M. Rich Nov. 1968 35 p
(NA-68-24; DS-68-23) Avail: Issuing Activity

Two types of experimental 20-channel flight data recorders were evaluated to determine their resistance to an aircraft crash environment. This crash environment was simulated by a series of four tests: a shock test, a crushing test, a penetration test, and a fire test. The first flight data recorder tested was an oscillographic recorder enveloped in a 1/2 ATR (Air Transport Radio) case; the recording medium was stainless steel tape. This recorder survived all the tests except the shock test in the longitudinal direction. A minor modification to the recorder would correct this fault. The second type of recorder was a magnetic tape recorder. This recorder was also destroyed in the longitudinal shock test. A major redesign would be required for this recorder to survive. It was concluded that the series of four crash survivability tests are poorly defined. Recommendations are made to correct this problem. Author

N69-10812# Japan Atomic Energy Research Inst., Tokyo.
ENERGY ABSORPTION SPECTRUM-RADIATION DOSE OPERATOR: PRINCIPLE AND THE AUTOMATION OF OPERATION
Ichiro Miyanaga et al Sep. 1968 26 p refs Transl. into ENGLISH from J. At. Energy Soc. Japan (Tokyo), v. 9, no. 8, Aug. 1967 p 440–446 and v. 9, no. 9, Sep. 1967 p 518–523
(NSJ-TR-137) Avail: CFSTI

A new method of determining the generalized operator is presented, which permits the treatment of any type of radiation dose with any detector system, and its characteristics are discussed. The generalized operator in an NaI (Tl) scintillation detector for the determination of gamma exposure (R), and the same in a liquid scintillation detector for neutron dose equivalent (rem) measurement are shown as examples. The generalized operator is a kind of weighting function to govern the energy absorption distribution function. In this respect, the methods based on time encoding and binary scaling are expedient for automatic weighting of energy. Both these methods however entail complex electronic circuits except in cases where the operator has the form of a linear function. For automatic operation of the generalized operator, it is shown that automatic discrimination bias modulation possesses the

flexibility required for adaption to any form of operator. This method uses A–C waves for the discrimination bias, which takes the form of inversed operator function, so that passage through gate of the input signal from the detector can be determined by its pulse height, and thus permits obtaining an output proportional to the radiation dose of interest. Electronic circuits are shown for possible forms of the operator function. Author

N69-10818# Explosives Research and Development Establishment, Waltham Abbey (England).
MEASUREMENT OF STIRRER-TO-WALL CLEARANCES IN UNLOADED MIXERS BY A CAPACITANCE PROXIMITY GAUGE
R. G. Williams 25 Jan. 1967 20 p refs
(ERDE-11/R/67; WAC-173/014) Avail: Issuing Activity

An inspection survey was made of the stirrer-to-wall clearances in a large closed mixer for propellent doughs by using a capacitance type proximity gauge. The sensing probe was replaced by a number of lightly constructed small metal plates. Clearances of 1/8 inch and below were measurable to an accuracy of about 0.005 inch, and the method is well suited to a comprehensive examination. It cannot be applied to monitoring clearances during mixing. Author

N69-10860*# Lowell Observatory, Flagstaff, Ariz.
A SCANNING POLARIMETER
John S. Hall 22 May 1968 6 p refs *Its* Bull. 143, Vol. 7, No. 6, p 61–66
(Grant NsG-451; Contract AF 19(628)-4070)
(NASA-CR-97668) Avail: CFSTI CSCL 20F

The polarimeter described is of the dual-beam type; a schematic diagram is included. A calcite Wollaston prism with a clear aperture of 24 mm and made of three elements, instead of the usual two, separates the beam into two components. The resulting ordinary and extraordinary images of the primary mirror projected on the cathodes are similar in shape and size. For parallel incident light the separation of the two beams emerging from the prism is 16°8 and 14°3 at wavelengths of 3600Å and 9000Å, respectively. Both the Wollaston prism and calcite depolarizer transmit the ultraviolet freely in the photoelectric region at wavelengths longer than 3000Å. Author

N69-10925# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE POSSIBILITY OF BALANCING GYROSCOPE ROTORS AT OPERATING SPEEDS
T. P. Kozlyaninov 24 Jan. 1968 36 p refs Transl. into ENGLISH from Uravnoveshivaniye Mashin i Priborov (Moscow), 1965 p 257–289
(AD-674871; FTD-MT-24-365-67) Avail: CFSTI CSCL 17/7

The author attempts to quantitatively evaluate the factors impeding efficient balancing of gyrorotors spinning at rates close to actual operating rates by investigating the performance of various balancing machines. A balancing machine with two rigid supports, equipped with pressure indicators for measuring dynamic pressures, a frame-type balancing machine, and a balancing machine with two movable supports were tested. It was found that it is impossible to improve the balancing of rotors using balancing machines with two rigid supports at high spinning rates without eliminating the play in the bushings and in the rotor shaft by introducing flexible elements. For this reason, the frame-type balancing machine must be provided with the means for displacing the frame supports in relation to the planes of correction. In a balancing machine with two movable supports, provision must be made for selecting the location of pressure indicators along the axis of the gyroscope. TAB

N69-10933*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESOLUTION CHANGES IN LITHIUM-DRIFTED SILICON SEMICONDUCTOR DETECTORS IRRADIATED WITH 0.8, 1.0, 2.0, AND 3.0 MeV ELECTRONS
Herbert D. Hendricks and Donald H. Phillips Washington Nov. 1968 32 p refs
(NASA-TN-D-4901) Avail: CFSTI CSCL 07E

Lithium-drifted silicon semiconductor detectors (2 mm deep and 80 mm^2 surface area) were irradiated with 0.8, 1.0, 2.0, and 3.0 MeV electrons. Fluence thresholds for damage were measured by monitoring resolution changes in the 0.972 MeV conversion electrons from ^{207}Bi. The fluence for 100-percent change in detector resolution was found to be approximately 10^{12} e/cm^2. Irradiations with 1 MeV electrons made at 10^7, 10^8, and 10^9 e/cm^2-sec gave no apparent flux dependence in the damage effects. Author

N69-10996# United Kingdom Atomic Energy Authority, Harwell (England).
REDUCTION OF X-RAY PROPORTIONAL COUNTER BACKGROUND BY PULSE SHAPE DISCRIMINATION
G. F. Snelling May 1968 23 p refs
(AERE-R-5749) Avail: CFSTI

The rise times of pulses produced by x-rays within an x-ray proportional counter are well defined and shorter than those of most of the background pulses. It is practicable to remove most of the background spectrum by means of pulse shape discrimination. The method adopted, using Harwell 2000 Series Units, together with some of the results obtained with a range of differing x-ray proportional counters, is described. Author (NSA)

N69-10999# General Electric Co., Philadelphia, Pa. Missile and Space Div.
RESEARCH ON AVALANCHE TYPE SEMICONDUCTOR RADIATION DETECTORS Semiannual Report, Jan.–Jun. 1968
Gerald C. Huth and Robert J. Locker Jun. 1968 68 p
(Contract AT(30-1)-3248)
(NYO-3248-TA-3) Avail: CFSTI

After a brief introduction on the characteristics of avalanche-type semiconductor detectors, results of a study on avalanche gain uniformity are presented. The results of an effort to measure and develop the response of silicon avalanche detector to low-energy electrons at 5 to 40 keV are also presented. Temperature compensation for avalanche detectors was investigated. Several applications for avalanche detectors were included. These were for plutonium detection in wounds, krypton-85, prototype heart catheter, and carbon-14 detection measurements. An appendix is included on the conceptual design for a flying spot scanning apparatus for measurement and study of gain uniformity in avalanche radiation detectors. NSA

N69-11041# Technische Hochschule Hannover (West Germany). Fakultaet fuer Bauwesen.
FUNDAMENTALS, PROCESSING AND MANUFACTURE OF LARGE SCALE AEROPHOTOGRAPHIC MAPS [GRUNDLAGEN, BEARBEITUNG UND HERSTELLUNG GROSSMASSSTAEBIGER LUFTBILDKARTEN]
Rudolf Konrad Schwalsthal (Ph.D. Thesis) 1967 104 p refs In GERMAN
(Repr.-34) Avail: CFSTI

This study examines the feasibility of covering large-scale, distortion-free aerial photographs by cartographic and reproductive measures to serve as substitutes for conventional topographic maps. The experimental part of the study centers on work with the German standard map of the scale 1:5000. The basic photogrammetric material is discussed, including correlation of photograph and map scales, techniques of aerial photography, and

elimination of distortion. Contrast, printing processes, and problems of reproduction are analyzed as well as basic cartographic methods for improving the accuracy of photomaps. Techniques for terrain representation, the use of color, updating of photomaps, and the feasibility of automating map production are considered.
Transl. by K.W.

N69-11060*# Franklin Inst., Philadelphia, Pa. Research Labs.
CALIBRATION RESISTOR FOR APOLLO STANDARD INITIATOR RESISTANCE MEASURING EQUIPMENT AIRME
Nov. 1967 7 p
(Contract NAS9-3787)
(NASA-CR-92370; FM-B2303-10) Avail: CFSTI CSCL 09C

The calibration resistor is designed to check the calibration of Apollo Initiator Resistance Measuring Equipment (AIRME). It supplements the built-in calibration standard in that it provides a check on the entire instrument, including the cable and adapter into which the initiator connects. The built-in standard does not check the cable and adapter. The unit is supplied with a shipping and carrying container. While there are only ten AIRME units in use, twenty calibration resistors were constructed so that one could be in use continuously while the other is being checked against a single secondary standard.
Author

N69-11092# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
CHARACTERISTIC INVESTIGATION OF THE GAS SCINTILLATOR IN THE ELECTRIC FIELD FOR CHARGED PARTICLE DETECTION AND SPECTROSCOPY
I. Kvitek, E. I. Nechaeva, Yu. P. Popov, I. Ribanski, R. F. Rumi et al 1968 13 p refs In RUSSIAN Presented at the 5th All-Union Conf. on the Syn., Production, and Use of Scintillators, Kharkov, 10–14 Jun. 1968
(JINR-P3-3904; CONF-680624-1) Avail: CFSTI

Here there are given some characteristics of the gas scintillator placed in the electric field. The possibility of constructing the detector and the spectrometer for charged particles on the gas scintillators in the field basis is also considered.
Author (NSA)

N69-11117#
MULTICHANNEL SYSTEM WITH VARIABLE SYNCHRONIZATION TO TELEMETER THE INTENSITY OF EVENTS OF STATIONARY POISSON PROCESS
R. F. Fedoriv [1968] 6 p refs Transl. into ENGLISH from the book "Metody Otbora i Preobrazov. Inform." Kiev, Naukova Dumka Press, 1967 p 113–119
Avail: CFSTI

Construction of a multichannel system with variable synchronization is shown to be feasible for the monitoring of nuclear radiation intensity, and the statistics are detailed of the intervals between radiation events distributed according to a Poisson law. Block diagram of the system and circuitry for its integrator are shown, and operation of the overall system is detailed. Error in measuring the radiation intensity is considered to be the same as for an ideal integrator recording.
M.W.R.

N69-11127# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Research.
CHECKING OF THE PICTURE PROCESSING FROM SPARK CHAMBERS
I. Bystritski, F. Lagar, Ya. Chekh, and Z. Yanout 1968 18 p refs In RUSSIAN
(JINR-P10-3910) Avail: Issuing Activity

The errors, appearing while scanning the pictures from spark chambers by using semi-automatic devices, are being considered. Statistical errors of the operator are measured and the systematic errors are estimated. A method is described by which statistical errors can be determined. It has been proven that the systematic errors can be reduced if the experimental material is scanned in parts by direct and mirror images. The measurement results are listed in tables and graphs.
Author (NSA)

N69-11150# United Kingdom Atomic Energy Authority, Harwell (England). Solid State Physics Div.
THE DIDO WHITE BEAM SCATTERING APPARATUS
T. Beirne Apr. 1968 14 p
(AERE-R-5698) Avail: CFSTI

A white beam apparatus for studying neutron scattering in magnetic materials by using small angle scattering techniques is described. The apparatus enables the spin wave contribution to the scattering to be isolated by comparing the numbers of scattered neutrons whilst the specimen is saturated by a magnetic field applied first parallel and then perpendicular to the scattering vector. The scattered neutrons are detected by five BF_3 counters which can be positioned from $-10°$ to $45°$ about the incident beam. Cryostats and furnaces are described which permit the specimen temperature to vary in the range 10°K to 1100°K.
Author (NSA)

N69-11164# Oak Ridge National Lab., Tenn.
PULSE-SHAPED DISCRIMINATION FOR BORON-LOADED LIQUID SCINTILLATION DETECTORS
L. Suetterlin 1967 5 p refs Transl. into ENGLISH from Atomkernenergie (Munich), v. 12, 1967 p 287–288
(ORNL-TR-1946) Avail: CFSTI

A pulse-shape-discrimination circuit is described for use on boron loaded liquid scintillation counters. The circuit described is a combination of the circuits developed by Brooks and Owen. Measurements show that the rate of discrimination is 1:2000.
Author (NSA)

N69-11171# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
THE HIGH RESOLUTION STUDY OF GAMMA RAYS FROM KeV NEUTRON CAPTURE
B. J. Allen Jul. 1968 31 p refs
(AAEC-TM-462) Avail: CFSTI

A Ge(Li) detector and time-of-flight system are used with an on-line computer to measure gamma rays emitted after keV neutron capture. The low efficiency of the Ge(Li) detector necessitates careful optimization of experimental parameters. Conflicting requirements of yield rate and timing resolution are discussed in terms of accelerator performance, target geometry and data-taking methods. The selection of suitable capture targets is considered.
Author (NSA)

N69-11184# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
ON THE DETERMINATION OF RECORDING EFFICIENCY OF GAMMA-QUANTA IN THE XENON BUBBLE CHAMBER
L. S. Okhrimenko, B. Slovinskii, and Z. S. Strugal'skii 1968 10 p refs In RUSSIAN
(JINR-P13-3918) Avail: CFSTI

A method is presented for the determination of γ-quants statistical weights, which were recorded in the xenon bubble chamber taking into account a chosen permissible error in the measurement of their energies (E_γ) according to previously developed methods.
Author (NSA)

N69-11204# Forsvarets Forskningsanstalt, Stockholm (Sweden).
HIGH-PRESSURE CELL FOR SIMULTANEOUS ELECTRICAL RESISTANCE MEASUREMENTS ON TWO SAMPLES IN SEPARATE CIRCUITS

G. Leman Jun. 1968 17 p refs
(FOA-4-4361-23) Avail: CFSTI

A high-pressure resistance cell for the simultaneous measurements on two samples in separate electrical circuits is presented. The cell is of the Drickamer type with supported anvils, and a method to insert a second circuit is described. The presence of this circuit is shown not to influence the relation between sample pressure and load. The determination of high pressures is discussed, and it is suggested that the method presented can simplify the calibration especially in the very-high-pressure region. The use of two samples in separate circuits instead of their series connection is shown to bring two advantages: the simultaneous investigation of substances with very different resistances, and the simultaneous study of phase transitions occurring at almost the same pressure. NSA

N69-11258*# LTV Aerospace Corp., Dallas, Tex. Research Center.
LTV BETA-BREMSSTRAHLUNG SPECTROMETER FOR GEMINI 12 Final Report
B. J. Farmer, N. E. Chappell, R. G. Bagwell, and W. J. Rainwater Mar. 1967 153 p
(Contract NAS9-5765)
(NASA-CR-92384; Rept-0-71000/7R-1) Avail: CFSTI CSCL 22B

Design and operation of a combination beta bremsstrahlung spectrometer and onboard data processor for Gemini XII is discussed. This instrument is mounted inside the spacecraft and monitors both electrons and X rays simultaneously. It combines the application of a complex scintillation crystal assembly with high speed electronic circuitry to identify and separate the two radiations from a mixed field. Flight data obtained by this system will be used to determine the spectra of radiation outside the spacecraft and the physical dose due to those radiations inside with their relative intensities after penetration. G.G.

N69-11274# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
COMPUTER-CONTROLLED DIFFRACTOMETER
P. J. Ellis and A. W. Pryor Jun. 1968 143 p refs
(AAEC/E-191) Avail: CFSTI

A computer-controlled neutron diffractometer is described for the collection of Bragg intensities from a single crystal. The computer is a PDP-8 with a store of 4096 12-bit words. The diffractometer is a 4-circle instrument with the axes driven by pulsed stepping-motors, while axis movement is checked by lightbeam markers. The programs include procedures for centering reflections, rotating about the scattering vector, calculating the setting angles in the bisecting and parallel positions, scanning over diffraction peaks, measuring backgrounds and generating ranges of Miller indices. Two similar diffractometers may be operated simultaneously
Author (NSA)

N69-11292# Joint Publications Research Service, Washington, D. C.
NARROWING THE MAGNETIC RESONANCE LINE IN A HELIUM MAGNETOMETER
B. F. Amirkhanov et al 28 Oct. 1968 7 p refs Transl. into ENGLISH from Geofiz. App. (USSR), no. 26, 1965 p 20-25
(JPRS-46759) Avail: SOD/CFSTI

The operating principle of the helium magnetometer, as with other radio optical magnetometers, is based on the resonance relationship of the output voltage of a photodetector to the magnetic field strength at a fixed frequency of the radio frequency resonance field. The higher the signal to noise ratio, the more sensitive the magnetometer and the smaller the width of the resonance line. The report indicates that reduction of the line width can be accomplished by reducing the intensity of the light source, however, the signal value is also altered. Tables indicate that in the case of pulse excitation, the width of the magnetic resonance line can be decreased almost 50 times as compared with the line width in the case of continuous discharge in the cell. Helium magnetometers with the pulse-type excitation of the absorbing cell have the following advantages: (1) a high resonance frequency; (2) a linear dependence of the resonance frequency upon the magnetic field strength; and (3) the possibility of normal operation in a broad range of change in the temperature of the ambient medium. The slight width of the magnetic resonance line in this device permits it to be used for measuring the magnetic field in outer space. A.L.

N69-11295*# Stanford Univ., Calif. Remote Sensing Lab.
FUNDAMENTAL STUDIES RELATING PARTICLE SIZE EFFECTS TO INFRARED SPECTRA Final Report, 1 Jun. 1967-31 May 1968
21 Jun. 1968 41 p refs
(Grant NGR-05-020-237)
(NASA-CR-97461) Avail: CFSTI CSCL 20F

Infrared spectra of powdered rocks were analyzed using the Stanford version of the Perkin-Elmer SG-4 spectrometer to determine whether particle size need be known before identification could be made by spectral emission analysis. The powders examined were: (1) quartz monzonite (June Lake, California); (2) basalt (Pisgah Crater, California); (3) pumice rock (Mono Craters, California); and (4) residue from a hypervelocity impact on a Mono Crater pumice. Results indicate that the positions of emissivity minima are not affected by the powder size; the depth of the minima diminishes as the powder size decreases; fine dust, such as normally occurs during the grinding process, dominates the spectral emission in the 7 to 14μ range of powdered samples; and using washed powder samples, the spectral features can still be seen at least to a particle size of 40μ. Goniometric functions of limestone and two granite faces were studied to determine the effects of surface roughness and angle of view of the spectrometer on emission spectrum variations. Parameters considered were variations in the average emissivity and the degree of spectral color (i.e., departure from mean value). In all three rocks examined, the maximum value of emissivity showed some slight decrease as the incidence angle decreased, but the minima decreased quite markedly, with the result that the spectral color was enhanced. A circularly variable filter (CVF) spectrometer was constructed which can be used with the SG-4. A brief description of design concepts of the system are given, and a diagram of the rebuilt field data system (truck mounted) is included. S.C.W.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N69-10055*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
PERFORMANCE AND ANALYSIS OF SEALS FOR INERTED LUBRICATION SYSTEMS OF TURBINE ENGINES
Robert L. Johnson, William R. Loomis, and Lawrence P. Ludwig Washington Aug. 1968 24 p refs
(NASA-TN-D-4761) Avail: CFSTI CSCL 11A

An inerted lubricating system incorporating a 125-millimeter ball bearing and 6.33-inch(161-mm-) diameter face contact seals was operated for short duration screening runs in a simulated turbine engine sump at speeds to 14,000 rpm and bulk oil temperatures to 500°F. The ball bearings operated satisfactorily to 600°F outer race temperature under a 3280-pound (14,590 N)

thrust load with four of the five lubricants evaluated in these short time runs. A persistent problem encountered was wear and leakage of the shaft seals. Additional experimental studies and analysis identified seal thermal deformation as a major factor in seal wear and leakage. New seals, revised to mitigate thermal deformations, were designed, analyzed, and subjected to preliminary experimental studies. Author

N69-10094 California Univ., Berkeley.
A NEW UPPER-BOUND APPROACH TO THE MECHANICS OF PLASTIC FLOW THROUGH CONVERGING DIES
Etienne Rene Lambert (Ph.D. Thesis) 1967 285 p
Avail: Univ. Microfilms: HC $12.85/Microfilm $3.70 Order No. 68-99

Two major developments were made in the upper-bound method for steady state plastic flow through converging dies. First, a flow function to define the velocity components was introduced, making available a wider selection of kinematically admissible velocity fields. The second development concerns the elimination of discontinuities in an admissible velocity field, which previously limited the usefulness of the upper-bound method. This was accomplished by the superposition of a finite or infinite number of basic flow patterns. After the velocity field is optimized, by minimizing the energy rate with respect to a limited number of undetermined parameters, strain rates, strains, stresses, and temperatures can be calculated at any point throughout the deforming material. Dissert. Abstr.

N69-10228*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTS ON THE STABILITY OF WATER LUBRICATED HERRINGBONE-GROOVE JOURNAL BEARINGS. 1: THEORETICAL CONSIDERATIONS AND CLEARANCE EFFECTS
Frederick T. Schuller, David P. Fleming, and William J. Anderson Washington Nov. 1968 30 p refs
(NASA-TN-D-4883) Avail: CFSTI CSCL 13I

Hydrodynamic journal bearing stability tests were conducted with three different herringbone journal configurations. The bearings had a 1.5-inch (3.8-cm) diameter and were tested in water at 80°F (300°K) at speeds to 12,000 rpm, with unit loads to 36.9 psi (25.4×10^4 N/m^2). The stability of herringbone-groove journal bearings was far superior to that of a 100° partial-arc bearing, especially at zero load. No significant differences in the zero load threshold of stability were observed among the three different configurations of herringbone journal bearings tested. Theoretical analysis for herringbone-groove journal bearings predicts a larger range of stable operation than was observed experimentally. Author

N69-10231*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INCOMPRESSIBLY LUBRICATED RAYLEIGH STEP JOURNAL BEARING. 2: INFINITE-LENGTH SOLUTION
Bernard J. Hamrock and William J. Anderson Washington Nov. 1968 28 p refs
(NASA-TN-D-4873) Avail: CFSTI CSCL 13I

A theoretical analysis of pressure distribution, load capacity, attitude angle, and friction force was performed for an eccentric Rayleigh step journal bearing with varying numbers of steps and infinite length. The results indicated that one step placed around the journal was optimal. For small eccentricity ratios the optimal film thickness ratio was 1.7, while there were three optimal ratios of the angle subtended by the ridge to the angle subtended by the pad of 0.4, 0.45, and 0.5. These ratios depend on whether load capacity, or stability, or both load capacity and stability is more important in the application being considered. Author

N69-10237# Los Alamos Scientific Lab., N. Mex.
ENCAPSULATION OF PLUTONIUM AND OTHER RADIOACTIVE MATERIALS IN WELDED CONTAINERS
J. W. Anderson and J. R. Nichols 18 Jul. 1968 12 p
(Contract W-7405-ENG-36)
(LA-3937) Avail: CFSTI

In connection with the charging and sealing of plutonium alloy into fuel capsules for LAMPRE (Los Alamos Molten Plutonium Reactor Experiment), production equipment and a procedure have been developed that have general application. Radioactive or other noxious materials are loaded into cylindrical containers without contaminating the outside of the containers, an inert atmosphere is provided, and the containers are welded shut. The equipment consists of a welding fixture, atmosphere controls, and a power supply. The procedure depends on careful handling and the convenience of the equipment. Author (NSA)

N69-10249*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF SURFACE FILMS ON FRICTION AND DEFORMATION OF SINGLE CRYSTAL AND POLYCRYSTALLINE GOLD
Donald H. Buckley Washington Nov. 1968 23 p refs
(NASA-TN-D-4875) Avail: CFSTI CSCL 11F

Sliding friction experiments were conducted with single crystal and polycrystalline gold with various media present. These included air, water, hexadecane, and hexadecane with 0.02 weight percent stearic acid; experiments were also conducted with various gold halide films formed on the surface. The alloying of copper with gold was also employed to improve the adsorbability of various media to gold. Results of the investigation indicate that ordinary atmospheric contaminants influenced the friction and deformation of gold. Water will not wet clean gold and thus provides the same friction and deformation behavior as that observed in air. The halides of gold all reduced friction and deformation of gold; the most effective halides were the chlorides for friction and iodides for deformation. The addition of a small concentration of copper to gold improved the ability of an organic acid to lubricate gold. Author

N69-10268# Los Alamos Scientific Lab., N. Mex.
JOINING GRAPHITE TO GRAPHITE WITH TRANSITION METAL FOILS
Donald J. Sandstrom 19 Jul. 1968 65 p refs
(Contract W-7405-ENG-36)
(LA-3960) Avail: CFSTI

Results of experiments to bond Fe, Mo, Ta, W, and Zr to a dimensionally stable high-coking graphite bonded with polymerized furfuryl alcohol resin are reported. It is concluded that the strongest solid-carbide joints will be produced with Zr and that fully diffused joints are superior to solid-carbide joints at elevated temperatures. The strength of joints produced with Fe were low. NSA

N69-10298*# Franklin Inst., Philadelphia, Pa. Research Labs.
STUDY OF PRETESTING EFFECTS ON ELECTROEXPLOSIVE DEVICES
M. G. Kelly and R. G. Amicone Washington NASA Nov. 1968 70 p refs
(Contract NAS1-6281)
(NASA-CR-1203; F-C1859) Avail: CFSTI CSCL 19A

The answers to a questionnaire sent to various NASA installations and suppliers dealing with the currently used pretesting practices are discussed. The currents used for bridge resistance and continuity checks vary from 20 μ amps to 20 mamps. No-fire and/or "1 amp, 1 watt" pretests are applied by almost all users and suppliers. Voltage breakdown and dielectric strength tests use voltages ranging from 50 to 1400 volts. Electrostatic tests involve

voltages of from 9 to 25 KV applied to the EED from a 500 pf capacitor. The no-fire test was judged to be one of the most severe pretests if applied to EEDs intended for actual use. Experiments were performed on EEDs using the results of the questionnaire as a guide. A severe version of the voltage breakdown test was used to condition COMMAND squibs, FOX squibs and MASSEY-1000 igniters. Subsequent tests showed no significant changes in the constant current sensitivity, functioning time, electrostatic sensitivity, and bridgewire power sensitivity due to the conditioning. A technique for the theoretical analysis of pretest effects is presented. Some knowledge of the EED thermal parameters is required for this approach. Author

N69-10370*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INFLUENCE OF NUMBER OF OPERABLE SLIP SYSTEMS ON FRICTION CHARACTERISTICS OF SINGLE-CRYSTAL AND POLYCRYSTALLINE MAGNESIUM

Donald H. Buckley Washington Jan. 1968 14 p refs

(NASA-TN-D-4351) Avail: CFSTI CSCL 11F

An investigation was conducted to determine the influences of a change in the number of operable slip systems in magnesium on its friction behavior. Friction experiments were conducted with a hemisphere sliding on a flat disk surface. The load was 50 grams and the sliding velocity was 0.001 centimeter per second. Single crystals of basal and prismatic orientations and polycrystalline magnesium were examined over the temperature range of −195° to 90°C. The results of this investigation indicate that the friction properties of magnesium, like other hexagonal metals, are anisotropic. Friction is lower on the basal than on the prismatic plane by a factor of 2. Multiple slip introduces greater ductility in polycrystalline magnesium and increases the friction. Friction is the lowest for polycrystalline magnesium at those temperatures where basal is the primary deformation slip mechanism. Author

N69-10377 Illinois Univ., Urbana.

AN INVESTIGATION TO DETERMINE THE SINGLE POINT CUTTING TOOL ANGLES WHICH YIELD MAXIMUM TOOL LIFE BY RESPONSE SURFACE METHODOLOGY AND EVOLUTIONARY OPERATION OF PROCESSES

Lloyd Louis Lehn (Ph.D. Thesis) 1967 173 p

Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-1797

The paper describes how the statistical tools of Response Surface Methodology can be combined with a digital computer analysis of data to solve a problem in a third discipline, metal cutting. Techniques are described which can be used to determine the geometry of a single point cutting tool which produces the maximum tool life when the tool geometry is the only variable of a machining operation. The basic difference between this paper and others dealing with the tool life-tool geometry relationship lies in the angles which are studied. Instead of using the standard angles of the tool signature, this investigation relates tool life to the functional angles of the tool. These are angles which must be calculated and cannot be directly measured on the tool. Dissert. Abstr.

N69-10629# Lund Univ. (Sweden). Machine Elements Div.

SUB-CAVITY PRESSURES AND NUMBER OF OIL STREAMERS IN CAVITATION REGIONS WITH SPECIAL REFERENCE TO THE INFINITE JOURNAL BEARING

Leif Floberg Stockholm Roy. Swed. Acad. of Eng. Sci. 1968 36 p refs Acta Polytech. Scand., Mech. Eng. Ser. No. 37

(ME-37) Avail: Issuing Activity

This report treats the cavitation phenomenon in journal bearings when consideration is taken for sub-cavity pressures. The influence of sub-cavity pressures will be pronounced at low loads. The size of the sub-cavity pressures decides the number of oil streamers in the cavitation regions. The mechanism of sub-cavity pressures is studied theoretically and experimentally. It is shown that the tensile strength of a liquid is dependent of the size of gas bubbles in the liquid and the surface tension. It is also shown experimentally that liquids can withstand pressures considerably lower than absolute vacuum. How the sub-cavity pressures influence the behaviour of cavitaion regions is shown for a journal bearing case of infinite width. The connection between the number of oil streamers in a cavitation region and the subcavity pressure is given. If the number of oil streamers is known, load capacities, oil flows, and the other bearing quantities can be determined. Author

N69-10749*# General Electric Co., Schenectady, N. Y. Research and Development Center.

STUDY OF DYNAMIC AND STATIC SEALS FOR LIQUID ROCKET ENGINES. SELECTED STUDIES FROM THE TECHNOLOGY OF MECHANICAL FACE SEALS Final Report, 1 Apr. 1967–1 Apr. 1968

1 May 1968 267 p refs

(Contract NAS7-434)

(NASA-CR-97575; S-68-1144) Avail: CFSTI CSCL 11A

Summarized are technical accomplishments achieved under a program designed (1) to advance the technology of dynamic and static seals for liquid rocket engines, and (2) to provide a basis for formulating design criteria for seals in future liquid rocket engines. Program tasks included studies of non-Newtonian and Newtonian sealing concepts; a non-Newtonian correlative model; seal geometry effects; and seal design theory. An extensive review of available literature on seals and sealing mechanisms was also made. S.C.W.

N69-10750# National Research Council of Canada, Ottawa (Ontario).

A METHOD OF CONTACT ANALYSIS FOR WILDHABER-NOVIKOV GEARING WITH A GENERAL CHOICE OF AXES. 3: CONTACT ANALYSIS OF W-N TYPE GEARING WITH INTERSECTING AXES [METHODE GENERALE D'ANALYSE DU CONTACT DES ENGRENAGES DU TYPE WILDHABER-NOVIKOV AUX AXES QUELCONQUES. 3: ANALYSE DU CONTACT D'ENGRENAGES DU TYPE W.-N. AUX AXES CONCOURANTS]

L.-J. Cloutier et al 1968 32 p refs Transl. into ENGLISH from the S.E.I.E. bull. (France), no. 53, 1967 p 3-28

(NRC-TT-1336) Avail: Issuing Activity

A general method (vectorial method) of contact analysis of Wildhaber-Novikov gears with a general choice of axes is developed and used to (1) define tooth flanks for cylindrical and bevel gears, and (2) to simulate actual operating conditions with errors of assembly and tooth corrections. The method was applied to five types of gears classifiable under the following two groups: (1) cylindrical gears with helical teeth (Novikov profile and Wildhaber profile) and spiral teeth, and (2) gears with intersecting axes with spiral teeth and helical teeth. Results of comparative studies of the effects of tooth parameters on sensitivity to errors of assembly and the nature of the contact are detailed. S.C.W.

N69-10757*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SLIDING FRICTION OF COPPER ALLOYS IN VACUUM

Jane Jellison, Roamer Predmore, and C. L. Staugaitis Washington Nov. 1968 20 p refs

(NASA-TN-D-4824) Avail: CFSTI CSCL 11F

Sliding friction experiments involving copper and Cu-Be alloy plates in contact with copper, Cu-Be alloy, steel and titanium

alloy sliders were performed in air and vacuum. Microhardness and metallographic examination of plate and slider interface suggests friction and wear by the adhesive friction mechanism with prow formation. Transfer of strain hardened metal wear debris across the sliding interface was observed. The friction coefficient and the prow size generally increased in vacuum. Author

N69-10908# Rock Island Arsenal Lab., Ill.
THE RESISTANCE OF GREASE LUBRICATED METAL COMBINATIONS TO FRETTING DAMAGE Final Report
S. Fred Calhoun Jun. 1967 16 p
(RIA-67-1594; AD-655276) Avail: CFSTI

Five different metals were oscillated against each other to assess the extent of fretting damage. They were all lubricated with the same grease and were subjected to the same pressures and vibration rates. The extent of the fretting damage was dependent upon the softness of the metals and also upon the nature of the metals in contact. Metal specimens oscillated against a like metal suffered less damage than when different metals were in contact. Author (TAB)

N69-11084# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF HYDROSTATIC THRUST BEARINGS
G. P. Kudryavtsev 3 Jan. 1968 13 p Transl. into ENGLISH from Politekhn. Inst., Kharkov. Vestn. (USSR), no. 1(49), 1965 p 134–142
(AD-675420; FTD-HT-23-1209-67) Avail: CFSTI CSCL 13/9

The author considers the use of hydrostatic bearings for eliminating semidry friction during starting and stopping conditions in high-power hydraulic generators where the combined weight of the wheel, rotor and shaft may be more than 1500 tons. The use of these bearings cuts the coefficient of friction during starting and stopping to a small fraction and reduces the energy of frictional forces to a minimum. Design of these bearings reduces to determining the necessary oil pressure, lifting capacity, rate of oil flow required for maintaining a film of a given thickness, power used in feeding the oil to the bearing and overcoming frictional forces and the temperature of the oil film. Formulas are given for determining these quantities in annular hydrostatic bearings used as the support surface for vertical shafts. TAB

N69-11271# Los Alamos Scientific Lab., N. Mex.
THE INTERACTION OF CONTROL VALVES WITH OSCILLATIONS GENERATED IN A LARGE WATER TO HYDROGEN HEAT EXCHANGER
J. B. Henshall, M. J. Nutter, F. J. Edeskuty, and R. S. Thurston 1967 8 p refs Presented at the Cryog. Eng. Conf., Cleveland
(Contract W-7405-ENG-36)
(LA-DC-9781; CONF-680813-1) Avail: CFSTI

Experiments performed to investigate the limiting conditions for stable operation of 4.46-in. ID H_2O–H_2 heat exchangers are described. Emphasis is placed on the interaction of control valves at the heat exchanger inlet and outlet and their association with internal oscillations. It is concluded that it is possible to isolate the external system from the oscillations and that introduction of valves with a fast response into a system that generates oscillations can result in dangerously high oscillation amplitudes. NSA

N69-11299# National Research Council of Canada, Ottawa (Ontario)
A METHOD OF CONTACT ANALYSIS FOR WILDHABER-NOVIKOV GEARING WITH A GENERAL CHOICE OF AXES. 2: CONTACT ANALYSIS OF W-N TYPE GEARING WITH PARALLEL AXES [METHODE GENERALE D'ANALYSE DU CONTACT DES ENGRENAGES DU TYPE WILDHABER-NOVIKOV AUX AXES QUELCONQUES. 2: ANALYSE DU CONTACT D'ENGRENAGES DU TYPE W.-N. AUX AXES PARALLELES]
L.-J. Cloutier and G.-V. Tordion 1968 55 p refs Transl. into ENGLISH from S.E.I.E. Bull. (France), no. 52, 1967 p 3–46
(NRC-TT-1335) Avail: CFSTI

Gears with parallel axes, helical teeth, and circular profile are considered in the contact analysis of Wildhaber-Novikov type gearing; and a comparison was made between Novikov teeth and Wildhaber teeth and errors in assembly and alignment were considered. In the case of gears with parallel axes, a straight line as a contact trajectory in the Z system and a constant velocity along this straight line resulted in helical teeth. Because of the greater conformity of the surfaces in contact, these teeth are easier to manufacture and are more resistant to wear than conventional teeth. Because these helical teeth have a convex-convex contact in the longitudinal plane, the development of gear with convex-concave contact was considered that satisfied double conformity in both the normal and longitudinal plane and still offered manufacturing simplicity. The resultant spiral teeth were found to have only one disavantage over the helical teeth, that is, the variation of the center distance affected the uniformity of rotation in spiral teeth. M.W.R.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N69-10262# Joint Publications Research Service, Washington, D. C.
USE OF LASER RADAR FOR INVESTIGATING ATMOSPHERIC PROPERTIES
O. K. Kostko *In its* Collection of Articles on Instr. for Studying Upper Atmosphere 22 Oct. 1968 p 88–110 refs (See N69-10251 01-14)
Avail: CFSTI

The possibility of using lasers for atmospheric studies is examined on the basis of some foreign investigations. Author

N69-10276 Illinois Univ., Urbana
FAR INFRARED LASER ACTION IN WATER VAPOR
William Quentin Jeffers (Ph.D. Thesis) 1967 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-1779

Stimulated emission spectra from the H_2O laser have been studied in the wavelength range 16 to 220 microns. This work is a first example of spiking in a far infrared laser and presents detailed measurements of the time-resolved emission spectra with pulsed operation of the laser. The results show that inversion on some of the laser transitions is dependent on thermal relaxation processes in the gas. A frequency selective resonator employing a diffraction grating was used in the wave-length region near 45 microns. This resonator's frequency selectivity allowed oscillation on several new emission lines and showed the effects of competition processes on lines which also oscillate with an ordinary resonator. The discharge tube used in this work made it possible to excite one half of the discharge independently of the other, making it possible to investigate relaxation processes of the laser specie on individual molecular transitions. These results show that the laser specie populations come to thermal equilibrium very rapidly on the laser transitions, but that they live in the laser states for much longer times. Dissert. Abstr.

N69-10416*# GCA Technology Div., GCA Corp., Bedford, Mass.
STUDY OF LASER DEPOSITED THIN FILMS Final Report, 4 May 1967–4 May 1968

James A. R. Simon Oct. 1968 21 p refs
(Contract NAS5-11033)
(NASA-CR-97595; GCA-TR-68-8-N) Avail: CFSTI CSCL 20E

The aim of this program has been to investigate the feasibility of using a pulsed laser beam as a heat source to evaporate metals for the production of high quality mirrors. In the course of this work it has been shown that the laser will evaporate all types of metals including the refractory types. Mirrors of Al, W, Mo, etc., have been produced. It was known that considerable "sputtering" of particulate material was produced when the metal was vaporized by a laser beam. This "sputtering" decreased the usefulness of the resulting mirrors. The program was thus aimed at understanding the mechanism of the unwanted "sputtering" in the hope that this would lead to the production of high quality mirrors. Considerable success has been achieved in this direction. Author

N69-10919# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPARISON OF PARAMETERS OF RUBY AND NEODYMIUM QUANTUM GENERATORS WITH PULSE HIGH QUALITY
Yu. F. Morgun et al 24 Nov. 1967 12 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii, Akad. Nauk Belorussk. SSR (Minsk), v. 4, no. 5, 1966 p 403–409
(AD-675453; FTD-MT-67-12) Avail: CFSTI CSCL 20/5

An investigation was made of a ruby laser operating in a pulsed Q-switching mode. Q-switching was controlled by rotating the prism of total internal reflection. The giant pulses obtained from the ruby laser differed from the pulses of the neodymium laser by their parameters. A neodymium laser generates a single pulse at a prism rotation speed of 25,500 rpm and a pumping energy of 2020 joules, while the ruby laser with the same rotation speed and a smaller pumping energy (1520 joules) generates 2-3 pulses which diminish in power. The parameters of ruby and neodymium lasers operating under similar conditions were compared. Neodymium glass rods and ruby rods with identical dimensions were used. The illuminator, the rotating prism, and the electrical and measuring parts of the installation in both cases were the same. The prism rotated at 24,000 rpm. The optimum mirror from the emergence side in the neodymium laser had a reflection coefficient of 60% and in the ruby laser, 42%. The investigations showed that the rate of resonator Q-switching, which determines the character of the laser emission, depends not only on the rotation speed of the prism but also on the optical properties of the active substance. TAB

N69-11072# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EMISSION BANDWIDTH OF RUBY LASERS
A. M. Sarzhevskiy et al 6 Dec. 1967 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 11, no. 2, 1967 p 112–114
(AD-675313; FTD-HT-23-1056-67) Avail: CFSTI CSCL 20/5

The emission bandwidth of ruby lasers with polished and frosted surfaces and with and without external mirrors was experimentally investigated at various distances between mirrors and at various levels of pumping energy. An IT-28 interferometer was used to measure spectral line width. The bandwidth of laser rods (80 mm long and 6.5 mm in diameter with coated ends) narrowed linearly from 0.21 to 0.13/cm as the pumping energy increased from 400 to 1200 j. Two emission frequencies approximately 0.75/cm apart were observed when 0.4 cm thick external mirrors were used instead of the dielectric coatings which is in agreement with theoretical data. The number of frequencies is a function of mirror thickness. Thus, four frequencies 0.24/cm apart were generated with mirrors 1.2 cm thick. Only one frequency is observed at a mirror thickness of 0.3 cm, a case similar to that with coated rod ends. The frequencies come closer as the distance between the mirror increases. Frosting of the rod surface reduces the line width by a factor of two for the same pump level. The difference between the laser frequencies is independent of pumping energy. Thus, the external mirror acts as a frequency selector for the axial modes and only those modes which correspond to an integral number of half-waves on the mirror substrate are excited. TAB

N69-11158# Westinghouse Research Labs., Pittsburgh, Pa.
PLASMA PRODUCTION BY A HIGH-POWER Q-SWITCHED LASER Quarterly Progress Report, 1 May–31 Jul. 1968
A. G. Engelhardt 1 Aug. 1968 5 p refs
(Contract AT(30-1)-3472)
(WERL-3472-11; QPR-2) Avail: CFSTI

During this period, Thomson scattering measurements of electron temperature and density were continued. The multichannel photomultiplier detection system was almost completed. Theoretical work was concerned with an evaluation of the thermokinetic theory. Brief descriptions of research progress on each are given. NSA

N69-11269#
POSSIBLE CHARACTERISTICS OF A BREHMSSTRAHLUNG SOURCE LASER PUMPING
V. B. Rozanov [1968] 3 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 182, no. 2, Sep. 1968 p 320–321
Avail: CFSTI

Characteristics of a coaxial discharge are analytically determined to demonstrate its feasibility as a radiation source for laser pumping. S.C.W.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N69-10002 Denver Univ., Colo.
A COMPRESSIBLE SPHERE THEORY OF LIQUID STRUCTURE. STRUCTURE OF LIQUID PALLADIUM-TIN ALLOYS
James Richard Guadagno (Ph.D. Thesis) 1967 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 67-17105

The compressible sphere theory of liquid structure is based on the assumption that the atoms in a monatomic liquid can be regarded as compressible spheres arranged in a random close packed manner. A two dimensional model has been developed, from which a radial distribution function has been derived which closely approximates published experimental data. The implications of this theory with regard to other properties of liquids are discussed. Experimental evidence, primarily that of the heat of solution of palladium in liquid tin, indicates that liquid palladium–tin alloys have a partially molecular structure between 600 and 800 K. Using indirect methods, the probable composition of the molecular species has been determined, and the relationship to the structures of solid Pd–Sn intermetallic compounds is discussed. The probable structures of a number of other binary liquid alloy systems are also discussed. Dissert. Abstr.

N69-10019 Northwestern Univ., Evanston, Ill.
EFFECT OF COMPETITIVE MECHANISMS UPON DENSIFICATION DURING THE INITIAL STAGE OF SINTERING AND SINTERING KINETICS OF IRON

Paul Hideo Shingu (Ph.D. Thesis) 1967 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-15339

The effect of material transport from the surface on the sintering behavior of spheres is studied. It is found that, the evaporation condensation mechanism becomes important as sintering proceeds whereas the surface diffusion mechanism is important initially and become less significant later. An equation which relates the amount of shrinkage and time needed for that shrinkage to take place is written taking the material transport mechanisms both from inside and outside of sintering spheres into account. With this equation, the sintering behavior of crystalline material can be calculated numerically. The theoretical experiment revealed that if the contribution of material transport from the sphere surface diffusion is overlooked, apparent value of D_V tends to be larger than the real value and the estimated value of D_V will be in error by relatively small amount, whereas the value for bD_B can be in large error. Dissert. Abstr.

N69-10045 Rensselaer Polytechnic Inst., Troy, N. Y.
THE INFLUENCE OF THE STRAIN HISTORY OF AUSTENITE UPON THE AUSTENITE-MARTENSITE TRANSFORMATION
Edward M. Breinan (Ph.D. Thesis) 1967 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-813

The purpose of this investigation was to quantitatively study this relationship, and to determine whether the observed dependence occurs through influence of the nucleation or the growth process. Austenite strength was measured in a high-temperature tensile apparatus, and the M_s temperature was determined magnetically during subsequent cooling. This investigation differed from previous work in two ways. The flow stress of austenite was measured directly, rather than inferred from some characteristic of the austenite, such as the alloy content or the degree of segregation. Additionally, in one part of the study, the flow stress of the austenite was varied by work hardening, while the austenite composition, which also affects M_s temperature, was held constant. A decrease in M_s temperature with increasing flow stress of austenite was noted. This decrease in M_s was supported by an observed decrease in the amount of austenite transformed to martensite at 25°C. The results were used to estimate the non-chemical free energy necessary to produce the volume deformation which accompanies martensite growth. Dissert. Abstr.

N69-10075 Illinois Univ., Chicago.
ISOTOPE EFFECT FOR DIFFUSION OF IRON IN VANADIUM
Michael Garm Coleman (Ph.D. Thesis) 1967 36 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-1726

The diffusion coefficients of iron, using Fe^{59} as the radioactive tracer, and the isotope effect parameter, using Fe^{58} and Fe^{59} as tracers, have been measured in vanadium over a temperature range of more than 800°C by standard sectioning and counting techniques. Vanadium is one of several body-centered cubic metals which show "anomalous" diffusional behavior. The diffusion of Fe^{59} in vanadium exhibits two straight lines on a ln D versus 1/T plot, with a change of slope occurring near 1350°C. The two straight line portions of this plot can be expressed directly as $D = 274.(\pm 15.)\exp(-92170.(\pm 105.)/RT)$ at high temperatures and by $D = 0.373(\pm 0.051)\exp(-71000.(\pm 180.)/RT)$ at low temperatures. These data can also be analyzed as the sum of two exponentials. Dissert. Abstr.

N69-10076 Brown Univ., Providence, R. I.
A FIELD ION MICROSCOPE INVESTIGATION OF THE DIFFUSION OF CARBON IN TUNGSTEN
Robert Dexter French (Ph.D. Thesis) 1967 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-1454

Volume diffusion of carbon in tungsten was studied with the ultra-high resolving power of the field-ion microscope. Carbon atoms in octahedral interstitial positions cannot be distinguished individually in the ion micrographs primarily because of their physical size relative to the size of a tungsten atom. At the limit of solubility of carbon in tungsten the carbon atoms have little, if any, disturbing effect on a clean tungsten image. The carbide W_2C appears mottled in the ion micrographs. Any planes which can be identified as such in the mottled area bear a near relation to a low index plane of the tungsten lattice. The carbide WC, identified by correlating the ion image with a $(2\bar{1}\bar{1}2)$ stereographic projection of WC, is related to the tungsten lattice in a similar fashion. Both observations are consistent with the expected mode of formation of the respective carbide structure from b.c.c. tungsten. Advance of the W_2C phase boundary along (011)-[112] zone lines appears to be associated with dislocations in the same region. The wedge-shaped appearance of the W_2C phase cutting through [112] planes suggests a boundary made up of perfect edge dislocations having a strength $b = a\sqrt{3/2}$. Dissert. Abstr.

N69-10090 Stanford Univ., Calif.
THE EFFECT OF DRILLED HOLES ON NOTCH TOUGHNESS
Charles Alfred Rau, Jr. (Ph.D. Thesis) 1967 278 p
Avail: Univ. Microfilms: HC $12.60/Microfilm $3.60 Order No. 67-17490

The effect of mechanically drilled holes on the notch toughness of iron base alloys was investigated by means of instrumented impact bend, slow bend, and tension testing. Although one small hole (diameter = 0.0292") drilled at or below the notch tip produces insignificant or adverse effects on the Charpy-V transition behavior, two holes located on each side of the notch produce considerable improvements. The important geometric parameters which determine the magnitude of the improvement were investigated. The impact transition temperature of drilled specimens can be as much as 60°C lower than that of standard Charpy samples. In addition, two holes increase the load carrying capacity of Charpy samples by as much as 100% at low temperatures where both specimens fracture completely by cleavage prior to general yielding. A photoelastic stress analysis revealed that these improvements are obtained without markedly reducing the elastic stress concentration factor of the notch. Dissert. Abstr.

N69-10169 Cincinnati Univ., Ohio.
THERMODYNAMIC PROPERTIES OF THE BODY-CENTERED CUBIC β PHASE IN THE TITANIUM-ALUMINUM SYSTEM
Raymond J. Usell, Jr. (Ph.D. Thesis) 1967 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-2024

Activities of titanium and aluminum are measured at 1780°K in the body-centered cubic β phase of the titanium-aluminum system, from zero to forty atomic percent aluminum, using three Knudsen Effusion-time-of-Flight Mass Spectrometer techniques. In the first technique the alloy of interest is placed in an ordinary Knudsen cell and the Al^{27} and Ti^{48} peak intensities are monitored as a function of composition from zero to forty atomic percent aluminum. In the second technique, aluminum weight loss experiments are carried out to determine the activity of aluminum as a function of composition from fifteen to forty atomic percent aluminum. In the third technique, a new Knudsen cell design is tested which allows activities to be determined in one short-time run in the TOFMS without altering geometry during the run. Combining the results of this research with earlier room temperature calorimetry work yields the excess molar free energy of mixing as a function of composition and temperature for the titanium-aluminum system. Dissert. Abstr.

N69-10175 North Carolina State Coll., Raleigh.
THE STRUCTURE OF INTERSTITIAL COMPOUNDS IN TERNARY METAL-BORON SYSTEMS
Gerhard Ambros Hofer (Ph.D. Thesis) 1966 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-550

In the first part of this dissertation an investigation has been made of the distribution of the metal atoms in the following ternary borides: $Ni_{20}Mg_3B_6$, $Ni_{19.5}Zn_{3.5}B_6$, $Co_{20}Al_3B_6$, $Ni_{20.5}Al_{2.5}B_6$, $Ni_{20}Al_3B_{9.75}$, $Ni_{21}Sn_2B_6$, which crystallize with the $Cr_{23}C_6$-structure (space group O_h^5–Fm3m). With the aid of x-ray diffraction techniques it was shown that for the above compounds the two different metal atoms are distributed in different atomic positions with the possible exception of the compound in the Ni–Zn–B system. It was confirmed that the existence of these phases depends on a geometrical factor and on the electron-to-atom ratio. In the second part, a crystal structure analysis of $Ni_6Zn_2B_3$ was carried out with single crystal X-ray diffraction techniques and Fourier synthesis. Dissert. Abstr.

N69-10179 Brown Univ., Providence, R. I.
AN EXPERIMENTAL STUDY OF THE STRENGTHENING MECHANISM AND FRACTURE BEHAVIOR OF SPHEROIDIZED CARBON STEELS
Chain-Tsuan Liu (Ph.D. Thesis) 1967 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-1479

The purpose of this work is to investigate experimentally the combined role of grain boundaries and carbide particles in the strengthening mechanism and fracture behavior of spheroidized carbon steels ranging in carbon content from 0.065 to 1.46%. The specimens were tested in tension to fracture. The application of the Petch type of strength-structure parameter equation to the yield and flow properties of spheroidized carbon steels is based on different effective structural barriers in various ranges of composition and strain. The mechanical behavior of L steels (0.065 and 0.30%C) is similar to that of polycrystalline iron and the Petch form of the strength-grain size relation has been found to be equally applicable to both the yield and flow stresses. In H steels (0.55 to 1.46%C), the strength data also satisfy the Petch equation based, however, on the particle spacing, which is associated with the dimensions of a dislocation cell structure formed during heat treatment and strengthened by deformation. Dissert. Abstr.

N69-10214# Finnish Academy of Technical Sciences, Helsinki.
SMALL ANGLE BOUNDARIES AND DYNAMIC RECOVERY IN ALUMINIUM-MAGNESIUM ALLOYS
V. K. Lindroos (Ph.D. Thesis—Inst. of Tech., Helsinki) 1968 52 p refs *Its* Acta Polytech. Scandinavica, Chem. including Met. Ser. No. 76
Avail: CFSTI

Dislocation arrays produced by solidification as well as by plastic deformation were investigated in aluminum-magnesium alloys. Structures containing different dislocation configurations were studied by means of X-ray diffraction, optical microscopy, and particularly by transmission electron microscopy. The emphasis was on: (1) knitting of dislocation networks on several types of forests under different solidification conditions in face-centered cubic crystals; and (2) the characteristics of dynamic recovery, i.e. annihilation of both vacancies and dislocations. The advantages of the moire technique for the study of misorientation as well as misfit across small-angle boundaries are discussed. The validity of the knitting mechanism is examined for the study of such other phenomena as creep and annealing recovery. K.W.

N69-10223*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE EFFECT OF SUBSTRATE STRUCTURE ON THE DEPOSITION OF EVAPORATED CARBON
D. B. Fischbach 15 Oct. 1968 10 p refs
(Contract NAS7-100)
(NASA-CR-97494; JPL-TR-32-1309) Avail: CFSTI CSCL 11B

A carbon deposition effect similar to that reported by Lewis and Floyd, but one that requires a different explanation, was discovered during studies of tensile creep on pyrolytic and glassy carbons. It was concluded: (1) the deposited carbon was evaporated from the coke-pitch graphite heating element; (2) the nucleation, growth, and adherence of evaporated carbon films at high temperatures is strongly dependent on the nature of the substrate surface. Author

N69-10226*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EFFECT OF SIZE ON TENSILE STRENGTH OF FINE POLYCRYSTALLINE NICKEL WIRES
Lester S. Rubenstein Washington Nov. 1968 24 p refs
(NASA-TN-D-4884) Avail: CFSTI CSCL 13I

Small-diameter (250 to 10 μm) polycrystalline nickel wires were prepared from single crystals and tested to relate tensile properties to wire size. Four conditions were tested: cold-drawn; drawn and electropolished; drawn and recrystallized; and drawn, recrystallized, and electropolished. The drawn wires were tested as a function of wire diameter, and recrystallized wires were tested at two grain sizes. The 0.2-percent yield strengths and tensile strengths of cold-drawn wires varied inversely as the square root of wire diameter. The tensile strength of recrystallized wires was diameter independent. The proportional limit stress of recrystallized wires was inversely related to power functions of wire diameter and grain size. This relation can be expressed by a modified Hall–Petch equation. Author

N69-10233*# Mississippi State Univ., State College. Dept. of Electrical Engineering.
AN INVESTIGATION OF THE DECOUPLING EFFECTS IN A MAGNETIC FORMING BERYLLIUM COIL ASSEMBLY
J. W. Rogers, D. D. Wier, and M. E. Davis Jun. 1968 56 p refs
(Contract NAS8-20399)
(NASA-CR-98076) Avail: CFSTI CSCL 13H

A beryllium coil assembly was developed by the National Aeronautics and Space Administration. The primary purpose of the hammer coil is to form metallic materials and reduce fatigue and work hardening. This study was made to determine the force exerted by the hammer coil on a plate as it becomes decoupled from the coil. The mutual coupling between the hammer coil and plate as a function of distance of separation was determined. Differential equations were derived which described the currents in a two ring hammer coil and plate circuit. The solution of these equations was determined by the analog computer. With the currents determined, the force of repulsion between the hammer coil and plate was determined. The induced current reached a maximum value of $(7)10^3$ amperes in the smallest ring, while a value of $(5.66)10^3$ amperes was reached in the second ring. This yielded a force of repulsion of approximately 2710 newtons/meter on the smallest ring. Author

N69-10301# Finnish Academy of Technical Sciences, Helsinki.
STRESS-INDUCED STACKING FAULTS IN ALPHA CU-AL ALLOYS
Aulis V. A. Saarinen (Ph.D. Thesis—Tech. Univ., Helsinki) 1968 87 p refs *Its* Acta Polytech. Scandinavica, Chem. including Met. Ser. No. 77
Avail: CFSTI

Mechanisms for the generation of stress-induced stacking faults in alpha-Cu-Al alloys were studied, as was the influence on faults of the overshoot phenomenon in single crystal tensile tests. Thermal annihilation of stacking faults and solute segregation into stacking faults were also observed, and the effect of stress-induced stacking faults upon polycrystalline stress corrosion failure was studied. Transmission electron microscopy was the primary research tool. It was found that large stacking faults were induced in an FCC crystal by stress when the resolved shear stress acting on the leading Shockley partial dislocation exceeded "critical tear stress." Thermal annihilation of stacking faults was considered due to the unlocked Shockley partial distribution or the nucleation of a new Shockley partial at high temperatures. In the Cu-7.48 wt%Al alloy, the Al segregates into stacking faults during annealing; and stacking faults were considered to be anodic with respect to the surrounding matrix for alpha-Cu-Al alloys in a corrosive NH_3 atmosphere. M.W.R.

N69-10345# Virginia Polytechnic Inst., Blacksburg. Dept. of Metals and Ceramic Engineering.
THE RELATIONSHIP OF NITROGEN CONTENT OF AUSTENITIC STAINLESS STEELS TO STRESS CORROSION Quarterly Report
Thomas B. Cox Jul. 1968 17 p refs
(Contract AT(40-1)-3208)
(TID-24567; QR-483-16) Avail: CFSTI

Specimens of Type 304 stainless steel with N contents ranging from 0.033 to 0.406 wt % were heat treated and aged to assure homogeneity and tested in boiling 42% $MgCl_2$ to determine effects of N and thermal aging on susceptibility to stress corrosion cracking. It was observed that increasing amounts of N in solid solution decreased times to crack-nucleation and to complete crack penetration while increasing rates of crack propagation. Thermal aging further reduced resistance to stress corrosion. The temperature dependence of solid solubility of N in Types 304, 308, and 384 stainless steels was determined. NSA

N69-10415*# Los Alamos Scientific Lab., N. Mex.
THE MANUFACTURE AND PROPERTIES OF AN EXTRUDED, RESIN-BONDED GRAPHITE, CMF-13 LOT AAQ1
Morton C. Smith 31 Oct. 1968 56 p refs
(NASA Order W-12595; Contract W-7405-ENG-36)
(NASA-CR-97594; LA-3981) Avail: CFSTI CSCL 11B

CMF-13 Lot AAQ1 is a relatively large sample of an extruded, resin-bonded graphite. It was manufactured from commercial raw materials, which are fully characterized, and using standard procedures, which are described in detail. The principal physical and mechanical properties of the finished graphite are listed, in most cases as functions of temperature. Author

N69-10512# National Research Council of Canada, Ottawa (Ontario).
FATIGUE TESTS ON NOTCHED SPECIMENS OF 2024-T351 ALUMINUM ALLOY UNDER A LOW ALTITUDE AIRCRAFT LOAD SPECTRUM
J. A. Dunsby May 1968 25 p refs
(LR-504; NRC-10329) Avail: Issuing Activity

Experiments are described in which notched specimens of 2024-T351 aluminum alloy were subjected to a fatigue load distribution typical of that encountered by an aircraft operating continuously at low altitude. While the experiments lack statistical validity, they serve to demonstrate the effects of design stress level on life and suggest that the lives of general purpose aircraft currently used in these roles may be as low as 2000 to 3000 hours. The particular load spectrum investigated imposes significant fatigue damage over a wide range of load levels and, because of the frequency of occurrence of the low loads, might lead to tests of excessive duration. Experiments in which the lower loads were omitted showed that the inaccuracy introduced by this process could be predicted to satisfactory level by the use of simple Miner linear cumulative damage hypothesis and that, in the particular example studies, the test duration could be halved for a loss in accuracy of test life as low as ten percent. Author

N69-10568# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
THE MECHANISM OF VOID GROWTH AND FACTORS AFFECTING THE ONSET OF INTERGRANULAR FAILURE DURING CREEP OF MAGNOX AL80
H. E. Evans Feb. 1968 23 p
(RD/B/N-1009) Avail: Issuing Activity

Tensile tests on Magnox AL80 were conducted at a strain rate of $10^{-3}hr^{-1}$ over the temperature range 25 to 400°C and grain size range 0.009 to 0.300 in. It is shown that the growth of voids occurs by a grain boundary sliding mechanism, and the variation of ductility in the intergranular failure range is interpreted by means of this parameter. The factors which lead to the onset of intergranular failure are discussed in terms of the relative ease of nucleation, and rate of growth of intragranular cracks and grain boundary cavities. Author (NSA)

N69-10572# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
FRACTURE MECHANICS EVALUATION OF REACTOR VESSEL STEELS Quarterly Progress Report, Period Ending 30 Jun. 1968
Jul. 1968 39 p refs
(Contract AT(30-1)-3677)
(WCAP-3677-8; EURAEC-2044) Avail: CFSTI

Measured tensile properties and Charpy V-notch data for preirradiated A533 (Trade B Class 1 steel are presented. Post-irradiation Charpy V-notch impact data are presented for A533 Grade B Class 1 steel. NSA

N69-10573# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
RESUSPENSION OF BERYLLIUM OXIDE POWDER
T. J. H. Warren and J. K. Copland Apr. 1968 24 p refs
(AAEC/TM-448) Avail: CFSTI

A series of experiments to examine the resuspension of beryllium oxide powder under various disturbance conditions is described. With powder deposited on a floor surface, basic disturbance actions were sweeping and walking, and other parameters included ventilation rate. Resuspension factors in the breathing zone ranged from 0.05×10^{-3} m^{-1} to 14×10^{-3} m^{-1}. An analysis of the results leads to a recommendation that a resuspension factor of 7×10^{-4} m^{-1} be used as a basis for determining Maximum Permissible Levels of beryllium surface contamination. Author (NSA)

N69-10575# Minnesota Univ., Minneapolis. Inst. of Technology.
DIFFUSION STUDIES IN LIQUID METALS Progress Report, 16 May 1967–15 Jun. 1968
R. A. Swain 15 Jun. 1968 20 p refs
(Contract AT(11-1)-84)
(COO-841-15) Avail: CFSTI

SODIUM—diffusion at constant volume of liquid, self-; radial distribution function of liquid, x-ray diffraction; NICKEL—diffusion in liquid silver; FURNACES—design for thermal diffusion experiments using liquid silver; SODIUM, POTASSIUM, RUBIDIUM—electric conductivity of liquid, experimental and theoretical. NSA

N69-10598*# Tyco Labs., Inc., Waltham, Mass.
STUDY OF THE GENERAL MECHANISM OF STRESS CORROSION OF ALUMINUM ALLOYS AND DEVELOPMENT OF TECHNIQUES FOR ITS DETECTION Quarterly Report, 1 Sep.–30 Nov. 1967
S. B. Brummer, R. O. Bell, F. H. Cocks, A. Cordellos, M. Krebs et al 30 Nov. 1967 170 p refs
(Contract NAS8-20297)
(NASA-CR-98099; QR-5) Avail: CFSTI CSCL 11F

The mechanism of the stress corrosion cracking of high strength aluminum alloys was investigated using electrochemical, mechanical, and electron microscopic techniques. Experiments were carried out, in 1M NaCl buffered to pH 4.7 at 30° C, using the commercial alloys 7075 and 2219 and relevant pure materials. The feasibility of detecting stress corrosion damage in fabricated aluminum alloy parts by nondestructive testing techniques was investigated using ultrasonic surface waves. The previous results on the strain-rate sensitivity of the stress–strain behavior of 7075 and 2219 and their relation to the stress corrosion cracking of these materials are explained in terms of an Orowan mechanism of cleavage. Deformation in air of large-grained samples of Al–7.5 Zn–2.4 Mg and Al–4 Cu indicates a relation between dislocation pileups and grain boundary cleavage in Al–Zn–Mg but not in Al–Cu. Studies of the corrosion of the 2219 system involved 2219 itself, pure Al–4 Cu, and $CuAl_2$. Brief studies of the corrosion of Mg_2Al_3 are reported. The distinguishing of the separate effects of corrosion and mechanical stress in stress corrosion of aluminum alloys is discussed. Author

N69-10609# Compagnie des Ateliers et Forges de la Loire, Paris (France).
STRESS CORROSION OF DIFFERENT STAINLESS STEELS IN CHLORIDE SOLUTIONS IN THE HOT STATE [CORROSION SOUS TENSION DE DIFFERENTS ACIERS INOXYDABLES DANS DES SOLUTIONS CHLORUREES A CHAUD]
A. Desestret, G. H. Wagner, and Ph. Berge 1968 223 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-033-64-9 TEEF)
(EUR-3764f) Avail: CFSTI

General corrosion and stress corrosion of austenitic stainless steels was investigated in solutions at temperatures up to 300° C and in steam up to 500° C. Eight grades of stainless steels were tested, four of which were austenitic grades and four austeno-ferritic grades, with separate or simultaneous additions of molybdenum and silicon. The steels were studied in magnesium, calcium, and sodium chloride solutions for the effects of physical and chemical phenomena on the microstructure. Corrosion behavior was also studied in the presence of water with traces of chlorides added. Changes in the mechanical properties and in the microstructure were observed, and the use of chrome plating for corrosion retardation was considered. K.W.

N69-10637*# Tyco Labs., Inc., Waltham, Mass.
STUDY OF THE GENERAL MECHANISM OF STRESS CORROSION OF ALUMINUM ALLOYS AND DEVELOPMENT OF TECHNIQUES FOR ITS DETECTION Annual Summary Report, 2 Jun. 1967–1 Jun. 1968
S. B. Brummer, R. O. Bell, F. H. Cocks, A. Cordellos, M. Krebs et al 1 Jun. 1968 122 p
(Contract NAS8-20297)
(NASA-CR-98098; ASR-2) Avail: CFSTI CSCL 11F

The mechanism of the stress corrosion cracking of high strength aluminum alloys has been investigated using electrochemical, mechanical, and electron microscopic techniques. Corrosion and stress corrosion experiments have been carried out in 1M NaCl buffered to pH 4.7 at 30°C, using the commercial alloys 7075 and 2219 and also relevant pure materials. The feasibility of detecting stress corrosion damage in fabricated aluminum alloy parts by nondestructive testing techniques has been investigated using ultrasonic surface waves (Rayleigh waves). Although the importance of metallurgical treatment on the susceptibility of aluminum alloys to stress corrosion is well-known, the underlying reasons for this sensitivity are not completely understood. This relationship has been explored for both pure and commercial alloys using electron microscopy and mechanical tests. Author

N69-10730# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
PRECIPITATION OF ALUMINUM FROM SUPERSATURATED SOLUTION IN ALPHA URANIUM
A. F. Smith May 1968 13 p refs
(RD/B/N-1013) Avail: Issuing Activity

The kinetics of the formation of precipitates from γ quenched adjusted uranium were studied by lattice parameter changes. It was established metallographically and by electron microscopy that only the phase UAl_2 precipitates on heating in the α phase. In the temperature range examined (350 to 600°C), the kinetics of precipitation are consistent with the nucleation and growth of precipitates on subgrain boundaries and on individual dislocations within subgrains. Author (NSA)

N69-10784*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
AN EVALUATION OF COATED MOLYBDENUM AND COLUMBIUM ALLOYS IN HIGH-TEMPERATURE SUPERSONIC AIRSTREAMS
Irvin M. Miller Washington Nov. 1968 32 p refs
(NASA-TN-D-4877) Avail: CFSTI CSCL 11F

An experimental study was made to investigate the oxidation behavior of four commercially coated refractory metal systems in supersonic airstreams: Durak B and Vought IX coated TZM, and Cr-Ti-Si and Cr-$MoSi_2$ coated Cb-752. Cyclic coasting life and temperature data were obtained on 0.375-inch-diameter (0.953 cm) blunt-nose models at surface temperatures from 2600° to 3000°F (1700° to 1920°K) and at air stagnation pressures behind the shock wave of 0.03, 0.10, and 5.5 atmospheres. The oxidation behavior of uncoated molybdenum- and columbium-alloy models of the same size and shape was also studied in the same test environments. Coating life of the TZM/Durak B, Cb-752/Cr-Ti-Si, and Cb-752/Cr-$MoSi_2$ systems was significantly lower at air stagnation pressures of 0.10 and 0.03 atmosphere than at 5.5 atmospheres. At these low-pressure conditions, the coating life of these three coating systems did not exceed 32 minutes. The uncoated columbium alloys oxidized catastrophically at air stagnation pressures of 0.10 and 0.03 atmosphere in less than 20 seconds at temperatures well below the melting points of the alloys. Author

N69-10770# Atomics International, Canoga Park, Calif.
HELIUM EMBRITTLEMENT IN TYPE 304 STAINLESS STEEL
D. Kramer, H. R. Brager, C. G. Rhodes, and A. G. Paid 5 Dec. 1967 31 p refs
(Contract AT(04-3)-701)
(NAA-SR-12601) Avail: CFSTI

Helium was uniformly injected into small tensile samples of Type 304 stainless steel to concentrations of 1×10^{-7} and 3×10^{-5} atom fraction helium. Subsequent tensile testing above 1000°F revealed progressive ductility loss—as measured by total elongation at rupture—with increasing temperature. This effect was more severe in samples with the high helium content where elongations at 1400°F were a third or less of those of control samples. Yield and tensile strengths remained unaltered by the presence of helium. Above 1200°F, grain boundary sliding, which results in intergranular cracking, becomes important. The cracks

begin as voids on carbide particles which act as obstacles to grain boundary sliding. In the presence of helium, bubbles attach themselves to these carbide particles and serve as void nuclei thereby accelerating the process. Bubbles are also more prevalent on grain boundaries, dislocations, and inclusion particles than isolated in the matrix. Author (NSA)

N69-10774# Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.
VANADIUM PURIFICATION Quarterly Progress Report, 1 Jan.–31 Mar. 1968
C. T. Wang, E. F. Barock, J. C. Vake, and S. S. Christopher Apr. 1968 43 p
(Contract AT(30-1)-3742)
(CEND-3742-336) Avail: CFSTI

A 100-pound high-purity V-15Cr-5Ti alloy ingot was produced with a total interstitial content of less than 400 ppM. The process developed for the production of the alloy ingot was as follows: aluminothermic reduction of V_2O_5; consolidation by electron beam melting of the reduced vanadium derbies; double electron beam melting; compaction of vanadium, titanium and chromium flakes and chips; and double arc melt, first in argon, then in vacuum. Author (NSA)

N69-10782# California Univ., Livermore. Lawrence Radiation Lab.
CONTAMINATION OF REACTIVE METALS IN VACUUM HEAT TREATING AT VARIOUS VACUUM LEVELS
R. F. Bunshah 5 Jul. 1968 16 p refs Presented at Vacuum Met. Conf., Beverly Hills, Calif., 1968
(Contract W-7405-eng-48)
(UCRL-71029; CONF-680623-1) Avail: CFSTI

During a vacuum exposure at 4×10^{-6} torr at 1800°C, significant contamination of tantalum with oxygen occurs in a short time. Contamination by carbon, nitrogen, and hydrogen is minor or negligible. During a vacuum exposure at 2×10^{-10} torr and 1400°C, there is no measurable contamination of tantalum. Tungsten is not contaminated over the pressure range 4×10^{-6} to 2×10^{-10} torr, presumably because of a dynamic balance between the contaminating and purifying reactions. Tantalum foil is an excellent passive monitor of the contamination during a long vacuum exposure. It should be included routinely in long creep exposures and analyzed for O, N, H and C after exposure. Author (NSA)

N69-10807# Japan Atomic Energy Research Inst., Tokyo.
ON THE POLYMORPHIC TRANSFORMATION OF ZIRCONIUM DIOXIDE ASSOCIATED WITH THE BREAKAWAY DURING HIGH TEMPERATURE OXIDATION OF ZR AND SOME ZR ALLOYS
Tadayuki Nakayama et al Sep. 1968 18 p refs Transl. into ENGLISH from J. Japan Inst. Metals (Sendai), v. 31, no. 7, Jul. 1967 p 839–845
(NSJ-TR-138) Avail: CFSTI

The breakaway phenomena of Zr and some Zr alloys during high temperature oxidation were studied from a structural point of view, by means of high temperature X-ray diffraction, thermal gravimetry, optical microscopy, and differential thermal analysis. The structural change in oxide scale at breakaway is in close relation with the polymorphic transformation of zirconium dioxide (tetragonal ↔ monoclinic). The continuous observation of change in oxide scales with high temperature X-ray diffraction clarified that black colored pre-breakaway oxide layers contained a considerable quantity of metastable tetragonal oxide, and that the color change of oxide layers from black to white and the polymorphic transformation to monoclinic oxide occurred simultaneously at breakaway. The contents of tetragonal modification in prebreakaway oxide scales on Zr alloys containing Ti or Sn were larger than that on pure Zr, and this agrees reasonably with the facts that the breakaway occurs at lower temperatures on those alloys, and that those elements lower the transformation temperature of zirconium dioxide. In the stable region of the tetragonal form, the breakaway did not occur in O_2 Author

N69-10816# Iowa State Univ. of Science and Technology, Ames.
GADOLINIUM-LEAD PHASE SYSTEM
John Talley Demel (M.S. Thesis) May 1968 35 p refs
(Contract W-7405-ENG-82)
(IS-T-240) Avail: CFSTI

The gadolinium–lead binary phase diagram has been determined by differential thermal analysis, metallographic and x-ray methods. The addition of lead to gadolinium lowers the α-β transformation from 1258 to 1212°C by an inverse peritectic transformation. Gadolinium additions to lead raise its melting temperature by a peritectic transformation from 327 to 328°C. The room temperature solid solubility is negligible for the pure materials. A eutectic transformation occurs at 14.5 at. % Pb and 1120°C. There are six intermetallic compounds; Gd_5Pb_3 melts congruently at 1670°C while Gd_5Pb_4, $Gd_{11}Pb_{10}$, Gd_8Pb_7, $GdPb_2$, and $GdPb_3$ melt peritectically at 1460, 1225, 1160, 1010 and 989°C, respectively. In addition there is a polymorphic transformation in Gd_5Pb_4 at 1410°C. The crystal structures of Gd_5Pb_3, Gd_5Pb_4 and $GdPb_3$ are discussed. Author (NSA)

N69-10826# Aeronautical Research Labs., Melbourne (Australia).
A STUDY OF THE UNLOADING YIELD POINT IN COPPER SINGLE CRYSTALS
S. McK. Cousland May 1968 17 p refs
(ARL/MET-54) Avail: Issuing Activity

A small yield point occurs upon reloading a crystal of a face-centred cubic metal which has been unloaded after straining: this effect was investigated in single crystals of copper. The observed variations of yield point size with flow stress, rest time, rest temperature, and reloading temperature lead to the conclusion that a dislocation/dislocation interaction is responsible for the pinning which gives rise to the yield point. It is suggested that point-defect mobility partly controls the frequency of occurrence of the pinning interaction, and hence influences the yield point size. Variations in rest temperature do not influence the flow stress, as measured after removal of the unloading yield point by extrapolation, but they do affect the yield point size. This observation shows that the procedure previously adopted for measuring the reversible change of flow stress is valid. Author

N69-10827*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FEASIBILITY OF PRODUCING DISPERSION STRENGTHENED CHROMIUM BY BALL-MILLING IN HYDROGEN HALIDES
Alan Arias Washington Nov. 1968 39 p refs
(NASA-TN-D-4912) Avail: CFSTI CSCL 11F

Chromium, with and without 4 volume percent thoria, and nickel powders were ground to fine powder sizes by ball milling in gaseous hydrogen halides. After reducing the milled chromium in flowing hydrogen under pulsating pressure at about 680°C, submicron size powders with 4 to 500 ppm residual halogens were obtained. The compacted chromium-thoria alloys had interparticle spacings ranging from 2.1 to 6.5 micrometers. After 100 hours at 1318° C the interparticle spacing of the 2.1-micrometer alloy increased to 5.2 micrometers. Submicron size chromium and nickel powders were also obtained by pulsating hydrogen reduction of their chlorides. Author

N69-10847# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.
SODIUM COMPONENTS DEVELOPMENT PROGRAM. MASS TRANSFER INVESTIGATIONS IN LIQUID METAL SYSTEMS Quarterly Progress Report, Sep.–Nov. 1967
Jan. 1968 45 p refs
(Contract AT(04-3)-189)
(GEAP-5582; QPR-3) Avail: CFSTI

Investigations of materials exposure, mechanical properties, and Na impurities effects in pumped Na systems operating under controlled purity conditions to maximum temperatures of 1300°F are examined. The design details and corrosion test conditions are given along with a schematic representation of the modified test loop and specimen locations. Results indicate that weld drawn Types 304 and 316 stainless steels should yield representative and uniform properties. Type 347 stainless steel and Incoloy 800 in the weld drawn condition, because of localized seam weld deformation, do not produce homogeneous mechanical property data. Further use of these materials in weld drawn tubing form is discouraged and seamless materials have been procured for future tests. Plugging mechanism studies in mass transfer loops confirm that hydrogen compounds are responsible for the high temperature break in the plugging indicator. Author (NSA)

N69-10853# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
CLOSED PACKED INTERMEDIATE PHASES, ESPECIALLY AB3 PHASES IN TRANSITION METAL SYSTEMS Final Report, 1 Apr. 1965–30 Mar. 1968
N. J. Grant and B. C. Giessen Mar. 1968 6 p refs
(Contract DA-31-124-ARO-D-329)
(AD-675467) Avail: CFSTI CSCL 11/6

A brief summary is given the results of work in the following areas: Crystal chemistry of close-packed transition metal phases of stoichiometry AB3; AB2 phases with transition metals and gold; effect of cold working on AB3 phases; study of gold-rich rare-earth alloy systems; study of related phases of stoichiometry other than AB3, especially A3B5 and AB2; metastable disordered close-packed phases with compositions near AB3; development of diffraction equipment based on powder diffraction spectrography (energy spectra). TAB

N69-10861*# State Univ. of New York, Stony Brook. College of Engineering.
THERMODYNAMIC PROPERTIES OF INTERSTITIAL ELEMENTS IN THE REFRACTORY METALS Semiannual Report, 1 Dec. 1967–31 May 1968
P. P. Bansal, N. C. Birla, A. C. Husng, and L. Seigle 31 May 1968 17 p refs
(Grant NGL-33-015-035)
(NASA-CR-97615; SAR-4) Avail: CFSTI CSCL 11F

Calculations of the thermodynamic properties of C in Mo, W, Cb, and Ta have been completed, allowing for the deviations from stoichiometry of the carbide phases in equilibrium with the terminal solid solutions. This allowance produces a minor correction in the previously determined values. Work is under way to extend the method to the oxygen and nitrogen containing systems. Values of the thermodynamic properties have also been calculated using elasticity theory to predict the "misfit" energy of the interstitial atoms in solution. For the carbon metal systems these are in reasonable agreement with the results of the phase diagram calculations. The solid electrolyte galvanic cell was used successfully to determine the free energy of formation of MoO_2 up to about 1100°C. Author

N69-10891# Ceskoslovenske Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
TECHNIQUES FOR MELTING AND CASTING OF URANIUM AND ITS DILUTE ALLOYS [TECHNOLOGIE TAVENI A ODLEVANI URANU A JEHO NIZKOPROCENTNICH SLITIN]
E. Kaderabek and L. Sokol May 1968 43 p refs In CZECH; ENGLISH summary
(UJV-1994) Avail: Issuing Activity

Equipment and techniques used for melting and casting of uranium and its alloys are reviewed. Refractory materials are assessed from the standpoint of their thermodynamic and other physical properties and compatibility with molten uranium. Also summarized are experimental results and experiences in melting and casting of uranium and some dilute alloys. Particular attention is paid to melting in crucibles of sintered alumina, chemical homogeneity problems and defects of castings. Author (NSA)

N69-10902*# IIT Research Inst., Chicago, Ill.
METAL CARBIDE-GRAPHITE COMPOSITES Summary Report No. 2, 1 Aug. 1967–31 Aug. 1968
15 Oct. 1968 140 p refs
(Contract NASr-65(09); IITRI Proj. G6003)
(NASA-CR-97616) Avail: CFSTI CSCL 11F

Studies were conducted on controlling the properties of hot-pressed metal carbide-graphite composites. The effects of starting material processing history, morphology, purity level, and shape relationships on properties were investigated. Other studies were conducted on the effect of processing temperatures on the bonding and strength of these composites. Mechanical property measurements were used as a measure of the changes which occurred. In addition, creep behavior was factored into their evaluation as high temperature thermal shock resistant materials. These experiments indicated that properties can be controlled and that additives can be employed to lower fabrication temperatures and produce sound composites. Author

N69-10931*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
ABSORPTION RATE STICKING PROBABILITIES FOR OXYGEN ON COLUMBIUM AND DILUTE COLUMBIUM-ZIRCONIUM ALLOYS
Charles A. Barrett Washington Nov. 1968 41 p refs
(NASA-TN-D-4885) Avail: CFSTI CSCL 11F

Sticking probabilities for oxygen on columbium and dilute columbium-zirconium alloys were derived from ratios of oxygen absorption rates to their corresponding oxygen fluxes. Oxygen test pressures were varied from 10^{-7} to 10^{-6} torr over temperatures between 1158 and 1373 K. The absorption rates were derived from a pressure-drop technique and fluxes from constant pressure measurements. The kinetics of the reaction are discussed as well as characteristics of the test method. Author

N69-10939# Societa Ricerche Impianti Nucleari, Saluggia (Italy).
INFLUENCE OF NITROGEN IN IRON AND STEEL UNDER FAST NEUTRON IRRADIATION Quarterly Report, 1 Jul.–30 Sep. 1968
F. S. Rossi Mar. 1968 7 p ref
(Contract EURATOM-074-65-10-TEER(RD))
(EUR-3982; EURAEC-2028; QR-8) Avail: CFSTI

Measurements were made of the tensile properties of irradiated and unirradiated Ferrovac E and of unirradiated Fe–Ti alloy specimens at different temperatures and strain rates: the range of strain rates was $1.5 \times 10^{-6} + 4.2 \times 10^{-1}$ sec^{-1}. Secondary hardening behavior was checked on unirradiated ASTM A 212 base steels killed with Si, Al, Ti after quenching from 1100°C and tempering at 600°C. Damage dosimetry studies with measurement of the irradiation induced modifications in Ultraperm magnetic properties were continued, and some tests were continued. Author (NSA)

N69-10942# Sandia Corp., Albuquerque, N. Mex.
REQUIREMENTS OF CAPSULE MATERIALS

J. R. Holland [1968] 26 p refs Presented at AIME Nucl. Met. Symp. on Mater. for Radioisotope Heat Sources, Gatlinburg, Tenn., Oct. 1968 Supported by AEC
(SC-DC-68-2385; CONF-681002-3) Avail: CFSTI

The requirements of capsule materials for radioisotope heat sources are reviewed and classified as those requirements resulting from: the type of fuel and its form; the operating conditions such as temperature and life; the anticipated and potential environments, such as launch accidents, space vacuum, and reentry; and considerations of mutual compatibility and stability. These requirements are discussed with regard to current practice, materials knowledge, and future needs with emphasis on space applications.
NSA

N69-10943# Kaiser Aluminum and Chemical Corp., Spokane, Wash. Dept. of Metallurgical Research.
CORROSION RESISTANT CLADDING FOR 7075-T6 ALUMINUM ALLOY Final Summary Report, 1 Jun. 1966–31 May 1968
Thomas A. Lowe Wright-Patterson AFB, Ohio AFSC Aug. 1968 28 p refs
(Contract AF 33(615)-3939)
(AD-675324; AFML-TR-68-212) Avail: CFSTI CSCL 11/6

One year atmospheric exposure test results indicated there are cladding alloys which offer improved corrosion resistance to clad 7075-T6 compared with 7072 clad 7075. These results confirm similar conclusions based on accelerated laboratory tests.
Author (TAB)

N69-10979# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ESTABLISHING THE TECHNIQUES OF PRESSURE WORKING OF NEW METALS AND ALLOYS
V. G. Osipov et al 26 Jan. 1968 15 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Inst. Metallurgi (Moscow), 1966 p 143–151
(AD-674912; FTD-MT-24-367-67) CSCL 11/6

Before the techniques of the hot and cold working of new metals and alloys can be developed, it is necessary to conduct research in: (a) the force parameters (distribution of unit pressures, torque, friction forces, deformation of unit pressures, torque, friction forces, deformation resistance and its dependence on temperature and rate of deformation and on phase transformations); (b) plasticity and its dependence on temperature, deformation rate, structural transformations and stressed state; (c) kinematics of change in shape. The results of research of this kind also reveal that what should be the optimal conditions of the prior heat treatment and rolling of the metals and alloys involved, as illustrated by investigations of flame-furnace heat treatment and rolling temperatures of various types of serial and experimental alpha-, (alpha + beta)- and beta-Ti alloys, carried out with the aid of specially developed testing devices at the Institute of Metallurgy im. A. A. Baykov and other organizations, which also are experimenting with the hot and cold working (forging and rolling) of new high-temperature, high-strength and corrosion-resistant Ti alloys. As another example, investigation of the plasticity of bars pressed and sintered from tungsten powder by various techniques (different conditions of pressing and sintering, different temperatures, pressures, time intervals, protective atmospheres, as well as different granulometric and chemical compositions of the powder) has led to the development of a process for manufacturing 30-50 microns thick vacuum-sintered tungsten-powder foil and strips.
Author (TAB)

N69-11012*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPRESSIVE PROPERTIES AND COLUMN EFFICIENCY OF METALS REINFORCED ON THE SURFACE WITH BONDED FILAMENTS
George W. Zender and H. Benson Dexter Washington Nov. 1968 47 p refs
(NASA-TN-D-4878) Avail: CFSTI CSCL 11D

Compressive tests were performed on metal tubes axially reinforced with filaments bonded to the tube outer surface. Sixty-eight magnesium, aluminum, and titanium tubes reinforced with boron or S-glass filaments were tested. The specimens consisted, by volume, of approximately 50 percent metal, 25 percent filament, and 25 percent epoxy resin. Remarkable mechanical properties indicating substantial weight-saving potential for aerospace structures were obtained. Mass-strength comparisons using the experimental results showed the boron-reinforced metals to weigh from 25 to 40 percent of the weight of titanium for compressive crushing strength and from 40 to 60 percent for column instability. Magnesium or aluminum reinforced with S-glass filaments weighs less than 50 percent of the weight titanium for compressive crushing strength and about 70 percent for column instability. The concept of bonding high-performance filaments to metal structures builds upon the large existing background of fabrication technology for aerospace structures. This advantage along with the potential weight saving indicated by test data suggests important practical application in structural design.
Author

N69-11013# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDYING THERMAL STRESSES IN CHROMIUM COATING ON MOLYBDENUM
V. Ye. Ivanov et al 27 Oct. 1967 8 p refs Transl. into ENGLISH from the Russian
(AD-675418; FTD-HT-23-668-67) Avail: CFSTI CSCL 11/3

Previous studies showed that coatings obtained by the condensation in vacuum of Cr vapors on the surface of Mo samples had good protective properties, but that their service life decreased considerably when they were subjected to temperature fluctuations. A study was made on the effect of temperature on internal stresses in chromium coatings on molybdenum produced in various vacuum conditions and having various strengths of adhesion of the coating to the substrate. The adhesion strength of coatings applied to the surfaces of oxidized and nonoxidized Mo were about the same and were similar to the strength of the coating.
Author (TAB)

N69-11020# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT EXCHANGE DURING THE BOILING OF MERCURY AND MAGNESIUM AMALGAM
M. I. Korneyev 8 Sep. 1967 27 p refs Transl. into ENGLISH from Zhidkie Metal. Sb. Statei (Moscow), 1963 p 220–224
(AD-675431; FTD-MT-23-667-67) Avail: CFSTI CSCL 11/6

Heat exchange intensification from the wall to boiling Hg may be accomplished hydrodynamically by increasing the flow rate with turbulence-producing inserts which destroy the vapor layer and improve surface washing, and phys.-chem. by improving Hg wettability by adding surface-active substances i.e., alkali and alk. earth metals, and removing the oxide film from the heat transfer surface. Large vols. of Hg and Mg amalgams were boiled at 1-10 atm. in vertical and horizontal tubes.
Author (TAB)

N69-11038*# City Coll. Research Foundation, New York.
FUNDAMENTALS OF THE OXIDATION PROTECTION OF COLUMBIUM AND TANTALUM Semiannual Report, 1 Apr.–1 Oct. 1968
M. Kolodney and R. A. Graff 1 Oct. 1968 24 p refs
(Grant NGR-33-013-017)
(NASA-CR-97999; SAR-6) Avail: CFSTI CSCL 11F

Thermochemical data is presented for the silicides, and the protection of both coating and substrate by the protective glass formed during oxidation was investigated. Under certain conditions

of temperature and pressure this glass does not form and the coating fails. The study of glass structure and growth is aimed at understanding the causes of failure and providing a rational basis for improving coatings. Since coating life may be limited by the formation of intermediate phases between the silicide and the substrate, these interactions are being investigated along with the efficacy of diffusion barriers to retard intermediate phase growth. The free energies of formulation of the tantalum silicides were determined. Fabrication of $TiSi_2$ specimens was improved and new oxidation rates determined. Oxide films were examined by infrared spectroscopy, X-ray diffraction and electron microscopy. Growth rates of intermediate phases in a number of diffusion couples were measured. Author

N69-11039# Battelle Memorial Inst., Columbus, Ohio. Columbus Labs.
THE INTERFACE ENERGIES OF REFRACTORY METALS Final Report
B. C. Allen 1 Jul. 1968 117 p refs
(Grant DA-ARO(D)-31-124-G779)
(AD-673793; AROD-3974-6-MC) Avail: CFSTI CSCL 11/6

The average solid surface free energy of molybdenum has been measured using the Udin zero creep method at 2500C under 1 atmosphere of tantalum-gettered argon. Grain boundary grooving has been studied in chromium, molybdenum, and tungsten under a variety of conditions using high vacuum techniques and tantalum-gettered argon. Surface free energy and surface self-diffusion of molybdenum were studied in the temperature range 1600-2400C using pressure-sintered bicrystals. The average solid-surface free energy of chromium of various interstitial contents, molybdenum, Mo-0.5Ti, and tungsten were measured by the multiphase equilibria technique utilizing interferometry and found to be 15-50 percent lower than the corresponding liquid surface tensions. Author (TAB)

N69-11044*# Norton Research Corp., Cambridge, Mass.
A STUDY OF THE ADHESION AND COHESION OF METALS Summary Report, 10 Mar. 1967–10 Mar. 1968
M. J. Hordon and M. A. Wright 10 Mar. 1968 45 p refs
(Contract NASw-1168; NRC Proj. 5116-1-1168)
(NASA-CR-97678) Avail: CFSTI CSCL 11F

Measurements of the interfacial adhesion force produced by the contact under axial loads of copper and nickel surface pairs in high vacuum were related to changes in the electrical resistance across the junction interface and to the plastic strain generated within the specimens. Estimates of the extent of the residual bonded zone for welded interfaces were made by metallographic sectioning. Under conditions in which contact surfaces were mechanically abraded at vacuum levels below 2×10^{-8} torr to remove adsorbed oxide films, adhesion or tensile rupture forces ranging up to 45 percent of the bulk maximum tensile load for annealed material were obtained with extensive plastic deformation. The adhesion bond efficiency was found to vary sensitively with plastic strain. The junction contact resistance was observed to decrease as W-1/3 where W was the applied load in the elastic range. For axial loads in the plastic range, the electrical resistance became negligible. For bonded interfaces, the resistance remained relatively constant with release of compressive load until the asperity contacts were ruptured. Author

N69-11061*# Texas Instruments Inc., Dallas. Materials and Services Group.
DETERMINING THE FEASIBILITY OF CHEMICAL VAPOR DEPOSITION PROCESS FOR THE PRODUCTION OF DISPERSOID STRENGTHENED CHROMIUM ALLOYS Final Report
Gene F. Wakefield and Richard D. Humphries 29 Nov. 1968 61 p
(Contract NAS3-10488)
(NASA-CR-72448; TI-04-68-12) Avail: CFSTI CSCL 13H

A chemical vapor deposition process was developed for preparation of chromium metal in dense, bulk form. Incorporation of a dispersoid phase of 0.01-micron thoria was only partially successful due to difficulties in feeding the fine powder. The chromium metal was higher purity and showed some ductility. Thermal treatment at 2600°F resulted in recrystallization and some reaction of chromium oxide inclusions with the matrix. Author

N69-11068# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VOLUME AND BOUNDARY DIFFUSION OF TUNGSTEN IN MOLYBDENUM
S. Z. Bokshteyn et al 6 Nov. 1967 16 p refs Transl. into ENGLISH from Protsessy Diffuzii, Struktura i Svoistva Metal., Sb. Statei (Moscow), 1964 p 25–35
(AD-675257; FTD-HT-23-887-67) Avail: CFSTI CSCL 11/6

Two methods of determination of the volume diffusion coefficient of tungsten in molybdenum were used: shift of activity curve; autoradiographic method. Radioactive 185 tungsten was deposited on the electropolished surface of the specimens; after diffusional annealing, microlayers were removed from the activated surface. The distribution of tungsten was determined by autoradiograms, while the amounts were determined by counting radioactivity. Author (TAB)

N69-11147# Kernforschungszentrum, Karlsruhe (West Germany). Inst. f. Material- und Festkoerperforschung.
INVESTIGATION OF IRRADIATION DAMAGE IN ZrO_2, ZrC AND UO_2, UN AND UC BY X-RAY DIFFRACTION
W. Dienst and D. Brucklacher [1968] 27 p refs Transl. into ENGLISH from German
(KFK-745; EURFNR-503; EUR-3711) Avail: CFSTI

Powder samples of ZrO_2 (cub. stable), ZrN, ZrC and UN, UC were irradiated in reactor FR 2 (Karlsruhe) at temperatures below 150°C to integrated fast neutron flows of $2.5\cdot10^{19}$ n/cm^2 (E>100 keV) or up to fission densities of $6.4\cdot10^{18}$ f/cm^3. With a röntgen counter tube goniometer for radio-active samples the changes in the lattice constants (Δ a/a ≈ $1\text{–}5\cdot10^{-3}$) caused through irradiation and the X-ray reflection widths were determined. It was possible to connect the differences in the Δ a/a saturation course for the zircon compounds with the fact that the resistance against the formation of large inter-lattice atom clusters increases during the transmission from predominantly ion to co-valent combination. The investigation results so far permit the supposition that the mobility of the point defects in the lattice of the uranium compounds in the order $UO_2 \rightarrow UC \rightarrow UN$. Author (NSA)

N69-11157# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
VANADIUM ALLOYS VERSUS STAINLESS STEEL FOR LMFBR CLADDING: PERFORMANCE AND ECONOMICS
G. Edison, R. Harrill, E. S. Schwartz, and G. A. Whitlow Jul. 1968 62 p refs
(Contract AT(30-1)-3791)
(WARD-3791-19) Avail: CFSTI

A comparison of economics and performance is made for vanadium alloy and stainless steel cladding in a carbide-fueled LMFBR. For a core coolant outlet temperature of 1000°F, the power cost with vanadium alloy cladding is about 0.07 to 0.09 mills/kWh higher than with stainless steel cladding. When the core coolant outlet temperature is raised to 1100°F for those core designs with vanadium alloy cladding, the power cost with vanadium is about 0.02 to 0.05 mills/kWh higher than with stainless steel. The power costs depend strongly on the projected fabrication cost of

vanadium alloy and stainless steel tubing. Several fabrication costs are considered, as well as different cladding thicknesses. Differences in nuclear performance characteristics such as fuel inventory breeding ratio and doubling time are less than one percent for all cladding materials and thicknesses studied. Doppler and sodium-void reactivity effects are five to ten percent more favorable with vanadium alloy cladding than with stainless steel. Based upon the available economic and performance data, a vanadium alloy appears to be an attractive first alternate to stainless steel for LMFBR cladding. Author (NSA)

N69-11173# Southampton Univ. (England). Inst. of Sound and Vibration Research.

STUDIES OF FATIGUE UNDER SINUSOIDAL AND RANDOM LOADING CONDITIONS

T. R. G. Williams and C. J. Taylor. Wright-Patterson AFB, Ohio AF Mater. Lab. Jun. 1968 42 p refs

(Contract AF 61(052)-862)

(AD-675188; AFML-TR-68-187) Avail: CFSTI CSCL 11/6

A program involving age hardening aluminum alloy L73 was undertaken to evaluate the response of this material to sinusoidal and random loading. The random stress pattern applied was derived from a resonance system, and the distribution of stresses conformed to a Rayleigh distribution of peaks at a narrow band frequency around 90 cycles per second. A discontinuity was observed in the sinusoidal S/N curves of the material associated with a change in fracture characteristics. The random loading results showed that the discontinuity was an important factor in the formulation of fatigue prediction theory. The results of testing mild steel under sinusoidal conditions are also presented. Author (TAB)

N69-11176# Department of Supply, Melbourne (Australia). Aeronautical Research Labs.

THE SUPERPLASTIC BEHAVIOUR OF THE ALUMINIUM-ZINC EUTECTOID

A. Ball and M. M. Hutchison Dec. 1967 43 p refs

(ARL-MET-70) Avail: Issuing Activity

It is shown that superplastic extension of the Al-Zn eutectoid results from extensive grain boundary sliding and grain rotation. A model is proposed in which small groups of grains, by reason of the orientation or alignment of their boundaries, coordinate their movement by sliding at these boundaries. However, the motion of such groups of grains is restricted by the necessity to deform obstructing grains. The above equation and the electron microscopy observations are discussed in terms of a mechanism involving the generation and motion of dislocations in obstructing grains. These dislocations pile up at the opposite grain boundaries until their back stress prevents further sliding of the groups of grains. However, under superplastic conditions, dislocations escape from the head of the pile-up by grain boundary diffusion, the rate of which is accelerated by the concentrated stress from the pile-up. As dislocations escape, the back stress decreases and further sliding occurs. The amount and rate of this sliding are thus controlled by the accelerated diffusion rate. Author

N69-11194# Virginia Polytechnic Inst., Blacksburg. Metals and Ceramic Engineering.

RELATIONSHIP OF NITROGEN CONTENT OF AUSTENITIC STAINLESS STEELS TO STRESS CORROSION

Thomas B. Cox and John F. Eckel Apr. 1968 22 p refs

(Contract AT(40-1)-3208)

(EURAEC-2026; Rept.-438-15) Avail: CFSTI

The solid solubility of nitrogen in AISI Type-384 stainless steel was determined for selected temperatures in the range of 538° to 982°C. Extensive experimentation and development of an acceptable thinning procedure have been carried out to facilitate the production of thin foils from the cracked Type-304 U-bend specimens. The thin foils are to be used in studying the stainless steel by transmission electron microscopy. Author (NSA)

N69-11208# California Univ., Livermore. Lawrence Radiation Lab.

THE YIELD SURFACE OF URANIUM PLUS .75 PERCENT TITANIUM

E. A. Green 30 Jul. 1968 45 p

(Contract W-7405-ENG-48)

(UCID-15362) Avail: CFSTI

The first and fourth quadrant yield surfaces were determined for a U–Ti alloy. The effect of electron beam welding was tested by making one complete specimen from identical halves welded together by this method. The testing program revealed that the weld metal is stronger than the off-weld metal. Fracture did not start or propagate through the weld. The tentative biaxial yield surface is best described by the maximum strain criterion and is poorly described by the Mises ellipse. The material is anisotropic; in biaxial stressing where the hoop and axial stresses were equal, the axial gages indicated 0.05% offset at a lower stress than the hoop gages. NSA

N69-11210# Instituto Sperimentale Dei Metalli Leggeri, Novara (Italy).

DISPERSION STRENGTHENED ALUMINIUM FOR NUCLEAR PURPOSES, WITH PARTICULAR EMPHASIS ON CORRELATION BETWEEN CREEP STRENGTH AND MICROSTRUCTURE PARAMETERS

D. Gualandi, D. Gelli, P. Jehenson (EURATOM), L. Mori, and M. Paganelli Ispra, Italy EURATOM 20 Jun. 1967 24 p refs Presented at the Intern. Conf. on the Strength of Metals and Alloys, Tokyo, 4–8 Sep. 1967

(Contract EURATOM-065-64-7 TEOI)

(EUR-4035.e; CONF-670909-9) Avail: CFSTI

Experimental data on the creep behavior of Al–Al_2O_3 composites, for nuclear fuel cladding, indicate that the high mechanical strength at elevated temperatures is correlated with very reduced grain size, stable at high temperatures, due to the presence of a dispersed phase. A marked increase in creep ductility of Al–Al_2O_3 composites is obtained by use of Al alloyed with 2 to 5% Mg, as the starting material, to transform the dispersed phase from Al_2O_3 to a mixed oxide MgO + MgO–Al_2O_3. NSA

N69-11234# United Kingdom Atomic Energy Authority, Springfields (England). Reactor Group.

A NOMOGRAM FOR THE PREDICTION OF EXTRUSION PRESSURES IN THE SIMPLE HYDROSTATIC EXTRUSION OF ROUND BAR THROUGH CONICAL DIES

P. J. Thompson and P. R. C. Daniels 14 Nov. 1967 19 p refs

(TRG-1523(S)) Avail: CFSTI

Some of the extrusion results obtained on the Fielding and Platt 200/50 'HYDROSTAT' at Springfields were used to construct a nomogram. This diagram enables the pressures for round-to-round extrusion through conical dies to be predicted from an equivalent stress-strain diagram produced from the results of a simple compression test performed on each material to be extruded. The results obtained from the nomogram indicate that the assumptions made in its construction are sufficiently valid to give first-order predictions of extrusion pressures. Author (NSA)

N69-11242# Franklin Inst., Philadelphia, Pa. Research Labs.

THERMALLY ACTIVATED DEFORMATION OF ALPHA ZIRCONIUM AND ALPHA ZIRCALOY. LWBR/LSBR DEVELOPMENT PROGRAM Final Technical Report

J. Hull and H. Conrad Aug. 1967 89 p refs Prepared for Bettis Atomic Power Lab., West Mifflin, Pa.
(F-C1834; TID-24570) Avail: CFSTI

The dislocation mechanism associated with the deformation dynamics of α-zirconium and Zircaloy at low temperatures (below 600°F) was evaluated from data available in the literature using the thermal activation analysis and Fleischer's model for solute hardening. It was established that this mechanism in both the unalloyed zirconium and in Zircaloy was the overcoming of interstitial impurity atom barriers by thermally activated dislocations moving on the first order prism planes, similar to titanium. However, the flow stress in zirconium and Zircaloy was proportional to the interstitial impurity concentration, in contrast to titanium where it varies with the square root of the concentration. It is felt that this is due to the fact that the lattice distortions associated with the major interstitial atom-oxygen-are nearly symmetrical in zirconium, whereas they are asymmetrical for titanium. NSA

N69-11275# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
HOT PRESSING OF BERYLLIUM OXIDE WITH ADDITIVES
J. Bardsley and G. Wulf Feb. 1968 21 p refs
(AAEC/TM-440) Avail: CFSTI

The effect of variations in temperature, pressure, and pressure cycle on the density vs grain size relationship was determined for hot pressed, sulfate-derived UOX beryllium oxide; the effects of selected additives on the final grain size using constant hot pressing conditions were also determined. A single-ended pressing technique, incorporating an incremental build-up in the pressing pressure, was developed to produce hot pressed specimens of near theoretical density with a uniform grain size of 25μ. Smaller grain sizes were not obtained by this technique owing to the onset of discontinuous grain growth at a bulk density of 97 per cent theoretical. However, by introducing an equilibration time at temperature before the application of the load, a theoretically dense specimen (3.010 g/cm^3) was produced with a uniform 8μ grain size. Carbon was the only additive which consistently refined the grain size at all levels of addition. NSA

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N69-10001 Kansas Univ., Lawrence.
TITANIUM-VANADIUM-OXYGEN SYSTEM
Sin-Shong (Ph.D. Thesis) 1967 400 p
Avail: Univ. Microfilms: HC $18.00/Microfilm $5.10 Order No. 68-600

Experimental studies on the tantanium-vanadium-oxygen system phase behavior, crystal structure, and vaporization behavior are presented. The phase behavior of the system were studied by X-ray diffraction techniques. Samples prepared in the MO region were found to disproportionate into sesquioxides and suboxides. A complete solid solution region from Ti_2O_3 to V_2O_3 and a new phase having the composition Ti_2VO_5 were established. A wide homogeneity range of VO_2 in TiO_2 was found. The symmetry of Ti_2VO_5 was found to be orthorhombic and that of $Ti_{0.5}V_{0.5}O_2$ was tetragonal. The vaporization behaviors of three compositions in the titanium-vanadium-oxygen system, V_2O_3, Ti_2VO_5, and $Ti_{0.5}$-$V_{0.5}O_2$, were investigated. A mass spectrometer was used to analyze the vapors effusing from a tungsten Knudsen crucible heated from 1200°C to 1800°C. X-ray diffraction techniques were used to identify phases present in the residues. The solid V_2O_3 vaporized congruently with vapor species VO, VO_2, V, V_2O_4, V_2O_3, and traces of interaction species WO_3, WO_2, VWO_5. Dissert. Abstr.

N69-10005 Illinois Univ., Urbana.
SINTERING KINETICS OF ULTRA FINE CALCIA STABILIZED ZIRCONIA
David Griffith Wirth, Jr. (Ph.D. Thesis) 1967 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-1887

Kinetics for the initial, intermediate, and final stages of sintering of ultrafine calcia stabilized zirconia were determined. Initial stage kinetics as determined by isothermal shrinkage measurements indicated a grain boundary mechanism of material transport was operative. The activation energy for sintering in this stage agreed quite closely with that for oxygen ion diffusion indicating that this species was rate controlling. This indicated that overall cation diffusion was enhanced. The results of intermediate stage kinetics as determined by isothermal porosity determination also indicated that oxygen ion was still the rate controlling diffusing species. The material transport mechanism was postulated to still be grain boundary diffusion based on the high grain boundary volume to bulk volume ratio as indicated by the small crystallite size and high activation energy for crystallite growth. Final stage kinetics as determined by isothermal grain growth studies indicated that rate control had been transferred to the cation species in the bulk. Dissert. Abstr.

N69-10025 Rensselaer Polytechnic Inst., Troy, N. Y.
VISCOSITY OF MOLTEN OXIDES AT ELEVATED PRESSURES
L. Louis Sperry (Ph.D. Thesis) 1967 179 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-845

The structure of molten B_2O_3 and binary melts containing B_2O_3 and Na_2O by means of viscosity measurements was studied. Constant volume and constant pressure data were obtained for the molten borates. Data on the effect of pressure upon the viscosity was combined with P-V-T data to calculate the results that would be obtained at constant volume. The results indicate that, for the molten borates, the activation energies at constant volume are nearly as large as those at constant pressure, which implies that flow in these liquids is limited primarily by potential energy barriers rather than by free volume. The experimental activation energy for B_2O_3 at constant volume was found to be much larger than that found from the "hybrid" equation. The isothermal compressibility of B_2O_3 at temperatures below 500°C was found to have a positive temperature coefficient in contrast to the results of other investigators who found a negative temperature coefficient at temperatures above 800°C. A three-state structural model proposed to account for the unusual flow and P-V-T properties of B_2O_3 assumed that flow occurs by segmental motion, without rupturing strong covalent bonds, except at relatively low temperatures. Dissert. Abstr.

N69-10027 Connecticut Univ., Storrs.
X-RAY STUDIES OF TERNARY OXIDES
Norman Louis Morrow (Ph.D. Thesis) 1967 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-1383

A phase of unknown stoichiometry was prepared by reacting lanthanum oxide, rhenium trioxide, and rhenium metal. Pure material could not be prepared in bulk, but X-ray diffraction studies indicated a body-centered cubic structure. Microscopic examination showed single crystals to be present. The material proved to be $La_6Re_8O_{19}$ with two of these units in a body-centered cubic cell of 9.03A. A three dimensional network of rhenium octahedra is the basis of the structure. Rhenium atoms occur in pairs.

presumably metal–metal bonded, with a 2.42A inter-rhenium distance. The lanthanums occur in groups of four, in open sections of the ReO_6 network, and are ten coordinate. Refinement of data on a crystal of orthorhombic potassium niobate, which is isomorphic with orthorhombic barium titanate, is reported; as is the refinement of the structure of zinc molybdenum oxide, Zn_2 Mo_3O_8. The zinc and molybdenum position parameters are confirmed, as reported by McCarroll and the oxygen parameters given. This compound was the first of the metal atom cluster type, and is of considerable interest as a result. Dissert. Abstr.

N69-10066*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A STUDY TO DETERMINE THE PRESENCE OF VOLTAGE BREAKDOWN DUE TO PROTON IRRADIATION IN POLYMERIC MATERIALS
Herbert D. Hendricks and William E. Miller Washington Nov. 1968 21 p refs
(NASA-TM-X-1688) Avail: CFSTI CSCL 11I

A study was made to determine proton induced voltage breakdowns in a series of polymeric materials: Kapton (H-film), Teflon (TFE), Pyrrone, Mylar, and polyethylene. Proton energy was varied from 0.40 to 3.25 MeV with a flux of 10^9, 10^{10}, 10^{11}, or 2×10^{11} protons/cm^2-sec. Samples were irradiated to a fluence of 10^{13} to 5×10^{14} protons/cm^2 for each test. Sample temperatures were 27°C and -134°C. No charge storage or induced voltage breakdown effects were observed. This observation is in sharp contrast to the numerous induced voltage breakdowns observed for electron irradiation of similar types of polymeric samples. A theory developed by Nichols and van Lint predicts that a behavior of this type should be less prevalent because of proton rather than electron irradiation. Author

N69-10105*# National Research Corp., Cambridge, Mass.
STUDY OF STRUCTURAL BEHAVIOR OF THIN FILMS First Year Summary Report
Earl E. Chadsey, Jr., Gabriel E. Padawer, and Frank Feakes [1967] 97 p refs
(Contract NASw-1553)
(NASA-CR-97472) Avail: CFSTI CSCL 11B

The feasibility of using boron carbide as the reinforcing phase in multi-layered structural laminates was determined. Procedures were developed for fabricating boron carbide laminates, both with aluminum and polyimide type substrates. An epoxy adhesive was used for the majority of the laminates. Laminates fabricated were subjected to mechanical tests which indicated tensile strengths, elastic modulus, compressive strength, compressive modulus, shear modulus, and interlaminar shear strength. The laminates had the following ranges of properties: 10.9 to 27.3% volume fraction of reinforcement; 4.6 to 16.9 $\times 10^6$ psi tensile modulus; 4.1 to 7.1 $\times 10^6$ psi shear modulus; 13.6 to 28.3 $\times 10^3$ psi tensile strength; 34.0 to 57.4 $\times 10^3$ psi flexural strength; 37.0 to 57.2 $\times 10^3$ psi compressive strength; and 3.7 to 6.7 $\times 10^3$ psi interlaminar shear strength. These values were essentially independent of orientation. Author

N69-10141 Virginia Polytechnic Inst., Blacksburg.
THE THERMODYNAMIC BEHAVIOR OF POLYETHYLENE AT ITS MELTING POINT
Nathan Waldman (Ph.D. Thesis) 1967 230 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 68-2077

The P-V-T behavior of three high density Marlex polyethylenes was studied in the melting range of the polymers. A dilatometric was constructed for the study that was capable of measuring volume changes as small as 1×10^{-5} cc at pressures up to 50,000 psig and temperatures up to 700°F. The constant temperature bath associated with the dilatometer was controlled to ± 0.005°F. In order to obtain the equilibrium melting point of high density polyethylene by dilatometric techniques, a sample preparation technique was developed that resulted in a sample of known and uniform thermal history. The importance of the sample thermal history was not fully appreciated by earlier investigators. The maximum deviation in specific volume for samples prepared by the technique was 0.84%. The compressibilities and expansivities of the polymers studied were dependent on the polymer molecular weights. The three polyethylenes studied differed only in their molecular weights which ranged from 47,000 to 147,000. Dissert. Abstr.

N69-10145# California Univ., Livermore. Lawrence Radiation Lab.
THE FATIGUE BEHAVIOR OF EP-1924 GRAPHITE AND A GENERALIZED DESIGN CRITERION
H. Leichter and E. Robinson 24 Oct. 1967 30 p refs
(UCRL-50337) Avail: CFSTI

The fatigue behavior of EP-1924 graphite was investigated in reverse bending up to 5×10^8 cycles at room temperature. A statistical analysis was made of fatigue life using a Weibull distribution and a homologous stress. The homologous stress is the ratio of applied stress in fatigue to the expected first-cycle strength. The first-cycle strength was calculated from the bending tests of similar material or "mate" specimens using the Weibull theory for correction of the significant size effect. Homologous stress gives a good correlation of life with stress for a wide variety of graphite grades and is thus recommended for the estimation of survival probability. The endurance limit for EP-1924 graphite was found to correspond to a homologous stress with other published data. Author (NSA)

N69-10156 Brown Univ., Providence, R. I.
A THEORETICAL AND EXPERIMENTAL STUDY OF HERTZIAN FRACTURES IN GLASS
Yu-Min Tsai (Ph.D. Thesis) 1967 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-1508

The apparent increase in the tensile strength of glass plates observed when measurements are made by pressing small spherical indenters on the surfaces of the plates is discussed in terms of the statistics of the surface flaw distribution. An analytic flaw distribution function is derived from the experimentally determined relation between radius of indenter and apparent tensile strength, and this function is used to forecast the scatter of observations about their mean values. In the second part of this thesis, the Hertzian fractures studied were produced by the impact of spheres onto the surfaces of glass blocks, and the work described comes under four separate headings. First, the appearance and geometrical form of the fractures were examined as a function of the impact velocity. The second study was concerned with measuring the coefficient of restitution as a function of velocity when fracture took place. The third investigation was to record the surface waves produced on glass blocks by impacts of steel balls and observe the effect that fracture has on the stress pulse which propagated out from the impact. A mathematical treatment of the wave propagation produced by such Hertzian impacts on an elastic half-space was made, and the pulse shapes for four distances of travel were predicted and compared with those observed experimentally. There was reasonable agreement between theory and experiment. Dissert. Abstr.

N69-10170 Stevens Inst. of Tech., Hoboken, N. J.
THE EFFECT OF ORIENTATION ON SOME THERMALLY DEPENDENT PROPERTIES OF ATACTIC POLYSTYRENE
Peter Norvel Britton, Jr. (Ph.D. Thesis) 1967 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-1154

The effects of the degree of orientation and the rate of cooling on the volume expansion, linear expansion, tensile stress,

and iso-strain modulus of atactic polystyrene were studied in the glassy and rubbery regions. These effects were studied experimentally by employing extremely sensitive dilatometric, linear expansion and stress-thermal experiments on polystyrene monofilaments. Three levels of orientation at each of two different cooling rates were imparted to the polystyrene during the extrusion into filaments. A direct correlation between the observations of the orientation effects in different experiments was possible, since all experiments were run at essentially static conditions. This was achieved experimentally by using a linear temperature programmer capable of rates of 0.1°C/min. Dissert. Abstr.

N69-10314# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE EQUATIONS FOR COUPLING BETWEEN STRESSES AND STRAINS IN GLASS-FIBER-REINFORCED PLASTICS

G. A. Van Fo Fy *In its* Appl. Mech. 14 Sep. 1967 p 10–19 refs (See N69-10312 01-32)
Avail: CFSTI

The equation of coupling between stresses and strains is derived on the basis of models of the inhomogeneous body for a single-ply layer of glass-fiber-reinforced plastic with consideration of the rheological properties of the binder. It is established that to describe the creep of a layer reinforced in one direction, it is necessary to take into account the time variation of the Poisson's coefficients and the elastic modulus of the binder. The theoretical formulas obtained are compared with the results of experimental studies of glass-fiber-reinforced plastics in the elastic region of binder deformation. Author

N69-10332# Aeronautical Research Labs., Melbourne (Australia).

KINK BANDS IN DEFORMED GRAPHITE CRYSTALS

L. M. Gillin Apr. 1968 15 p refs
(ARL/MET-53)Avail: CFSTI

Natural graphite crystals deformed in tension at 2400°C show plastic extension and large kink bands which are aligned along $<10\bar{1}0>$ directions. Consideration is given to the mechanism of the formation of deformation twins under tensile loads, and to the glide and interaction of twins. A proposal is made for the formation of these kink bands. Author

N69-10348# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

ANNUAL REPORT OF THE JAPANESE ASSOCIATION FOR RADIATION RESEARCH ON POLYMERS, VOLUME 8: 1966–1967 [NIPPON HOSHASEN KOBUNSHI KENKYU KYOKAI NEMPO, 8: (1966–1967)]

1967 230 p refs Transl. from Japan. Annual Report
(AEC-TR-6937) Avail: CFSTI

In the reports presented, research emphasis is placed on irradiation of polymers, radiation-induced polymerizations and physicochemical measurements to study polymerization active species, and electron spin resonance measurements of organic and inorganic compounds. For individual titles, see N69-10348 through N69-10369.

N69-10349# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

ENERGY SPECTRUM OF ELECTRONS IN POLYSTYRENE

Yohta Nakai et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 6–11 refs (See N69-10348 01-18) Avail: CFSTI

The slowing down spectrum of secondary electrons in polystyrene was obtained experimentally for well collimated, monoenergetic electron beams of one MeV from a Van de Graaff accelerator. The intensity of the electron was measured as a function of the energy. The peaks of the spectrum were shifted to the low energy region with increasing thickness of polystyrene foils. Discussion on integrative quantity of the spectrum is limited, because the linearity of scintillator was poor below 100 keV. Author (NSA)

N69-10350# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

OXYGEN UPTAKE DURING IRRADIATION AND POST IRRADIATION GRAFT COPOLYMERIZATION OF STYRENE ONTO POLYVINYL ALCOHOL

Fujiko Kimura et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 12–20 refs (See N69-10348 01-18) Avail: CFSTI

Flaked and powdered polyvinyl alcohol, which was subjected to heat treatment at various temperatures, was irradiated with γ rays in air of 200 mm Hg at 25, 40, and 60° C and the amount of oxygen consumed was measured by means of mass spectroscopy. After measuring oxygen uptake, graft copolymerization of styrene onto the preirradiated polyvinyl alcohol was carried out in vacuo. The amount of oxygen consumed decreased linearly with rising temperature of heat treatment, and increased with rising irradiation temperature. The results suggest that oxygen uptake during irradiation decreased with increasing crystallinity. The percentage of graft was not observed to change with heat treatment. Therefore, the percentage graft was independent of the amount of oxygen consumed. Author (NSA)

N69-10351# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

PROPERTIES OF STYRENE GRAFTED CELLULOSE

Fujiko Kimura et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 21–32 refs (See N69-10348 01-18) Avail: CFSTI

The water repellency of styrene grafted cellulose prepared by two different methods of radioinduced grafting was compared. Sample E was obtained by grafting in an aqueous emulsion of the monomer and S by grafting in a styrene–methanol–water solution. Cotton and rayon cloths were employed for the experiments. In both cases sample S showed much higher water repellency than E. The degree of swelling in water for sample E was much higher than that for S. Similar samples of grafted cellulose were also prepared from cotton and rayon fibers. It was found that the grafted fibers of rayon could be drawn to twice their original length in suitable liquids such as xylene and dimethylformamide at an elevated temperature. The drawing was very effective in obtaining styrene grafted rayon of high tenacity. Tearing strength, especially that of wet, styrene grafted rayon cloths, was studied. The low wet tearing strength was attributed to radiation damage during preirradiation; styrene grafting had little effect on improving the wet tearing strength of rayon. Author (NSA)

N69-10352# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

GASEOUS PRODUCTS FROM POLY (VINYL ALCOHOL) AND DEUTERATED POLY (VINYL ALCOHOL) WITH GAMMA IRRADIATION

Toshio Okada *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 33–44 refs (See N69-10348 01-18) Avail: CFSTI

Gases evolved from the gamma radiolysis of deuterated and normal polyvinyl alcohol were studied using a mass spectrometer over a temperature range of 12 to −196°C. The evolved gas was composed of above 99% hydrogen and a small amount of carbon dioxide, carbon monoxide, and methane. The deuterium isotope effect was very small in the irradiation at 12°C, but it increased with decreasing temperature. The irradiation at −196°C gave an isotope effect of 2.27. The isotopic composition of evolved hydrogen gas

did not appreciably differ from that of the polymer. The cleavage of the hydrogen–oxygen bond in polyvinyl alcohol is discussed.
Author (NSA)

N69-10353# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
EFFECT OF BENZALIZATION AND BENZOYLATION ON IRRADIATION DAMAGE OF POLYVINYL ALCOHOL FILMS
Kanako Kohdera et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 45–53 refs (See N69-10348 01-18)
Avail: CFSTI

Polyvinyl alcohol (PVA), and benzalized and benzoylated PVA films were exposed to γ rays in vacuo and in air. At the dosage of 2×10^7 R, the tensile strength of PVA film was 1.2 times as great as that of nonirradiated one. After the dosage of 6×10^7 R, the tensile strength was found to be still above its original value. Elongation decreased continuously with increasing dose. The tensile strength of benzalized PVA decreased sharply with irradiation in air and remained unchanged with irradiation in vacuo. In the case of benzoylated PVA, the tensile strength remained unchanged with the dosage up to 6×10^7 R both in vacuo and in air. Shapes of ESR spectra in derivatives of PVA were different from that of PVA. G-values for free radial formation in PVA and its derivatives at 25°C calculated from the initial slope of the radical concentration-dose curves were as follows: G(R·) in vacuo = 10.7 for PVA, 2.5 for benzalized PVA, and 0.8 for benzoylated PVA; G(R·) in air = 5.9 for PVA, 0.5 for benzalized PVA, and 0.8 for benzoylated PVA.
Author (NSA)

N69-10354# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
RADIATION INDUCED POLYMERIZATION OF SOME CYCLIC MONOMERS IN LIQUID STATE
Katsuji Ueno et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 54–58 refs (See N69-10348 01-18)
Avail: CFSTI

The radioinduced polymerization of some pure cyclic monomers in the liquid state was studied under extremely anhydrous conditions. Only 3,3-bis(chloromethyl)-oxetane (BCMO) and trioxane (TOX) gave fairly high yields and molecular weights, but under the same conditions, other cyclic ethers such as tetrahydrofuran did not polymerize. The polymerizations of BCMO and TOX were very sensitive to drying conditions, and their polymerization mechanism may be cationic.
Author (NSA)

N69-10355# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
FREE ION MECHANISM ON RADIATION INDUCED POLYMERIZATION OF ISOBUTYL VINYL ETHER
Katsuji Ueno et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 59–68 refs (See N69-10348 01-18)
Avail: CFSTI

The radioinduced cationic polymerization of bulk isobutyl vinyl ether was studied under anhydrous conditions. It was found that the rate of polymerization is proportional to about the square root of dose rate where relatively low doses were used. A mechanism involving bimolecular termination of free ions was therefore indicated. The lifetime of polymerization was measured directly by the pulse irradiation method. A preliminary result showed that it is 0.2 sec in the conditions of 42.5°C and 5.3×10^4 R/hr.
Author (NSA)

N69-10356# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
EFFECT OF HIGH ELECTRIC FIELD ON POLYMERIZATION OF STYRENE
Katsuji Ueno et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 59–68 refs (See N69-10348 01-18)
Avail: CFSTI

The radioinduced cationic polymerization of bulk styrene was studied under a high electric field. It was found that the rate of polymerization at 25°C increased with application of the electric field of 6kV/cm, leveling off at a higher electric field. The results were interpreted in terms of the increase of free ions and the relative lifetime of both positive ions (growing chains) and negative ions under a high electric field.
Author (NSA)

N69-10357# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
EFFECT OF ELECTRON SCAVENGERS ON POLYMERIZATION OF STYRENE
Katsuji Ueno et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 75–83 refs (See N69-10348 01-18)
Avail: CFSTI

The role of ejected electrons on the radioinduced cationic polymerization of bulk styrene was investigated. The addition of typical electron scavengers such as nitrous oxide and dichloromethane did not affect the rate of polymerization. The relative ratio of electron trapping between styrene and scavenger was measured in the solution of 3-methylpentane. The results indicated that styrene as well as nitrous oxide and dichloromethane are good electron scavengers. The existence of the anion radical of styrene was confirmed by ESR and electronic spectroscopy measurements.
Author (NSA)

N69-10360# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
MASS SPECTRA OF PYRIDINE AND PICOLINES
Kozo Tsuji et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 104–108 refs (See N69-10348 01-18)
Avail: CFSTI

Mass spectra of pyridine and pentadeuterated pyridine were observed and fragment ions were identified. Some discussions about fragmentation were made. Mass spectra of three kinds of picolines were observed. A symmetric form of parent ion was proposed during the process $(93^+) \rightarrow (66^+) + 27$. Some other mechanisms of fragmentation were also discussed.
Author

N69-10361# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.
ESR STUDY ON THE IRRADIATED ORGANIC GLASS CONTAINING STYRENE
Kozo Tsuji et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 109–116 refs (See N69-10348 01-18)
Avail: CFSTI

When styrene was irradiated by ionizing radiations at 77°K, it gave a five line ESR spectrum with a hyperfine coupling constant of 16 G. This spectrum was attributed to free radicals, $CH_3\dot{C}HC_6H_5$. Irradiated 2-methyltetrahydrofuran glass containing styrene gave, at 77°K, a signal shape composed of a broad singlet spectrum (total width of 33 G) and a seven line spectrum, but a sharp singlet spectrum due to trapped electrons which was found from irradiated pure 2-methyltetrahydrofuran glass was not observed. The seven line spectrum was due to free radicals formed from 2-methyltetrahydrofuran. The broad singlet spectrum was thought to be due to styrene anion radicals formed through electron capture by styrene. This spectrum was bleached by visible light. The same was found for 3-methylpentane glass containing styrene.
Author (NSA)

N69-10363# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

ESR STUDY OF IRRADIATED POLYOXYMETHYLENE

Kozo Tsuji et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 133–144 refs (See N69-10348 01-18)

Avail: CFSTI

Electron spin resonance spectra of irradiated polyoxymethylene were observed immediately after the irradiation and after heat treatments. ESR spectra changed with radiation dose and heat treatment after the irradiation. When radiation dose was very small, the doublet spectrum observed at room temperature was asymmetric, which was found to be caused by superposition of a singlet spectrum. This singlet spectrum could be assigned to the free radical, $-O-\dot{C}-O$. The effects of air were also examined. Peroxy radicals were produced at about −78°C in powder samples but not in pellet samples. It is thought to be due to difference of ease in diffusion of oxygen. The peroxy radical disappeared at room temperature. Other free radicals were also observed in irradiated polyoxymethylene in this investigation. One of them gives a doublet spectrum with a separation of about 86 gauss, and is tentatively assigned to $HO-\dot{C}-O$. The other is the formyl radical, which gives a doublet spectrum with a separation of 125 gauss. Author (NSA)

N69-10368# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Div.

ESR STUDY OF IRRADIATED POLYETHERS

Shun-Ichi Sugimoto et al *In its* Ann. Rept. of the Japan. Assoc. for Radiation Res. on Polymers 1967 p 184–191 refs (See N69-10348 01-18)

Avail: CFSTI

Free radicals formed in polyethers irradiated at low temperature were studied by ESR. A doublet–triplet spectrum was observed in irradiated polytetramethylene oxide and polydecamethylene oxide. The doublet splitting was 30 gauss and the triplet had 18 gauss splitting. The free radical responsible for this spectrum was assigned to $-CH_2\dot{C}HOCH_2-$. In polyethylene oxide–urea complex, however, the spectrum was a triplet of 21 gauss splitting. This spectrum could also be assigned to radical similar to the above mentioned one, where the conformation of the methylene group is different from the latter. Author (NSA)

N69-10631# Thermo Electron Engineering Corp., Waltham, Mass.

RESEARCH AND DEVELOPMENT OF VACUUM FOIL-TYPE INSULATION FOR RADIOISOTOPE POWER SYSTEMS Phase 2 Quarterly Progress Report No. 3, Mar.–May 1968

J. Carvalho, J. B. Dunlay, J. Fronduto, V. L. Poirer, and M. L. Paquin 26 Jul. 1968 68 p

(Contract AT(30-1)-3634)

(TE-4059-16-69; ALO-3634-9) Avail: CFSTI

Progress is reported on the development of high-temperature thermal insulation for radioisotope power systems. A new planar heat transfer test apparatus has been fabricated and is now in use. To date, twenty planar insulation samples have been fabricated and tested. These tests indicate that for a given particle size, the optimum oxide coating is the minimum amount consistent with complete foil separation. The performance of a planar insulation sample subjected to compressive stresses up to 5.11 psi is also presented. The operating characteristics of a modified cylindrical heat transfer apparatus are discussed. The low temperature material compatibility tests have been completed and a low temperature heat transfer apparatus has been designed and fabricated. Author (NSA)

N69-10724# Washington State Univ., Pullman. Chemical Research Section.

THE GRAFTING OF ORGANIC POLYMERS ONTO INORGANIC SUBSTANCES Final Report

R. A. V. Raff 30 Jan. 1968 109 p refs

(Contract AT(45-1)-2043)

(RLO-2043-2) Avail: CFSTI

Work reported in the literature on the grafting of organic polymers onto inorganic substances is reviewed. Topics treated are: adhesion of polymers to inorganic substrates; glass fiber reinforced laminates; grafting on glass fiber treated with titanium tetrachloride; adsorption of polymers on inorganic substances; pretreatment of clay surfaces; catalyzed polymerization of gaseous monomers at a liquid–gas interface; polymerization on freshly formed inorganic surfaces; polymer formation on electric contacts and on sliding metals; polymer grafting on carbon blacks; radiation polymerization on inorganic substances; polymer grafting on inorganic substances in polymer processing; biological significance of polymer grafting on inorganics; techniques of graft characterization; and, summary and conclusions. NSA

N69-10754*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CRYSTALLOGRAPHIC DATA ON SELECTED ARTIFICIAL GRAPHITES WITH COMMENTS ON THE ROLE OF THE DEGREE OF CRYSTAL DEVELOPMENT IN OXIDATION

Howard G. Maahs Washington Nov. 1968 18 p refs

(NASA-TN-D-4888) Avail: CFSTI CSCL 11I

Crystallographic parameters have been measured by X ray diffraction on 40 grades of commercially available, nonpyrolytic, artificial graphite (that is, industrially manufactured graphite consisting of filler and binder). The parameters measured are the lattice dimensions (a and d_c), and the crystallite diameter and height. Since artificial graphite is composed of a mixture of two or more graphite carbons, the measured crystallographic parameters are apparent only and are truly representative of neither the filler nor the binder. However, the measured interlayer spacing of artificial graphite is a good approximation of that of the filler. A survey of the literature indicates that the less graphitic a carbon, the less resistant the carbon is to oxidation. For this reason the binder in artificial graphite should be locally more reactive than the filler. Therefore, the aerodynamic erosion resistance of artificial graphite may be largely dependent on the binder, particularly in high-shear environments in which filler particles may be mechanically removed because of preferential oxidation of the binder matrix. Author

N69-11088# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE STUDY OF THE CONSTRUCTION OF GLASS BY VARIOUS PHYSICAL METHODS

V. A. Florinskaya 6 Nov. 1967 16 p refs Transl. into ENGLISH from Russian

(AD-675253; FTD-HT-23-873-67) Avail: CFSTI CSCL 11/2

The structure of glass was studied by infrared spectroscopy in the following directions: (1) Study of infrared spectra of various types of crystalline and amorphous silica and their changes with time; (2) study of the structure of the simplest and multicomponent glasses; (3) study of the life of crystalline and vitreous silicates: (a) when the charge changes into the melt; (b) in the melt; (c) in monolithic glasses; (d) during crystallization over a wide temperature range starting near the liquidus and ending in the annealing region; (e) in the crystallization products (processes of polymorphic transformations, solid-phase reactions, decomposition processes). Author (TAB)

N69-11152# Royal Aircraft Establishment, Farnborough (England).

AN EVALUATION OF SOME RAIN REPELLENTS FOR AIRCRAFT GLASS WINDSCREENS

J. D. Booker and M. J. B. Nash Dec. 1968 34 p refs

(RAE-TR-68375) Avail: CFSTI

Tests of several rain repellents were made on a glass windscreen in conditions of simulated flight through rain. The effects of high and low temperatures on the repellents after application

to glass were also investigated. The majority of the materials were found to improve considerably vision through the screen in rain. The materials tested were of two main types, those intended for application to the windscreen by hand and those intended for application in flight by means of a spray system. The relative merits of the two systems are discussed. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N69-10008 Cornell Univ., Ithaca, N. Y.
SOME LIMIT THEOREMS IN QUEUING THEORY
Atma Prakash Lalchandani (Ph.D. Thesis) 1967 81 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-883

Stochastic processes, arising in various queuing systems with traffic intensity greater than or equal to unity, are studied to obtain limit theorems. The phase length process arising in a Poisson input, generalized Erlangian service queuing model (Luchak's model) is investigated. It is shown that the distribution of this Markov process with a denumerable state space converges to the distribution of Brownian motion as the traffic intensity approaches unity (from above as well as below), using appropriate norming factors. This convergence is obtained by considering the convergence of the jump chain associated with the Markov process. On the other hand, imbedded Markov chains arising in G|G|1, G|E$_k$|1 and E$_k$|G|1 are considered. These chains are imbedded in the queue length and waiting time processes and can be represented as the maximum of a sequence of partial sums of independent and identically distributed random variables. Consequently, some limit theorems for this maximum are obtained. Two cases are considered depending on whether the basic random variables have zero or finite positive mean. These theorems are applied to the imbedded chains to obtain non-degenerate limit theorems for the queuing system. The corresponding cases here are the cases where the traffic intensity is fixed at a value equal to unity or greater than unity. Dissert. Abstr.

N69-10014 Tulane Univ., New Orleans, La.
ABSTRACT UNIVERSAL ALGEBRA
Robert Clay Davis, Jr. (Ph.D. Thesis) 1967 133 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 67-17906

The purpose of this paper is to investigate the relationships between various approaches to a theory of universal algebra on objects of general categories. First, the category of triples and the category of theories over an arbitrary category are defined and are shown to be equivalent. Then it is shown that a triple and the corresponding theory give rise to equivalent categories of algebras, and that a map of triples and the corresponding map of theories give rise to equivalent functors between the algebra categories. The "semantics functor," which takes triples to categories of algebras, is shown to be full and faithful, and the problem of characterizing "triplable" categories is discussed. Dissert. Abstr.

N69-10060 Michigan Univ., Ann Arbor.
EQUILIBRIUM POINTS OF N-PERSON DIFFERENTIAL GAMES
James Howard Case (Ph.D. Thesis) 1967 145 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-17740

We consider a differential game G between the players 1, 2, ... N whose state is governed by the equation $\dot{x} = f(t, x, u_1, \ldots, u_N)$, where u_i is a control vector belonging to player i, and suppose that each player i wishes to manipulate his control vector u_i in such a way as to minimize a functional $J_i = K_i(x(t_0)) + \int_{t_0}^{t_f} L_i(t, x(t), u_1(t), \ldots, u_N(t))\,dt$. Here t_0 and t_f are respectively the times at which the game begins and ends. A strategy N-tuple $u_1 = \phi^*_1(t,x), \ldots, u_N = \phi^*_N(t,x)$ is called an equilibrium point for G if the inequalities $J_i(\phi^*_1, \ldots, \phi^*_N) \leq J_i(\ldots, \phi^*_{i-1}, \phi_i, \phi^*_{i+1}, \ldots)$ hold for each $i = 1, \ldots, N$ and for each admissible strategy $u_i = \phi_i(t,x)$ for the player i. We seek methods of finding equilibrium points for the game G. Thus our problem is a generalization of that considered first by Isaacs and later by Berkovitz and Fleming, Pontryagin, and others. Dissert. Abstr.

N69-10061 Oregon State Univ., Corvallis.
PERIODIC SOLUTIONS OF PARABOLIC PARTIAL DIFFERENTIAL EQUATIONS
Stanley Jerome Farlow (Ph.D. Thesis) 1968 59 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-17570

It is proved that: if the coefficients of a second order parabolic equation in an infinite space-time cylinder, $D \times (-\infty, \infty)$; the nonhomogeneous term; and the mixed data on the boundary of $D \times (-\infty, \infty)$, are all periodic in t with period T, then there exists a solution in $\bar{D} \times (-\infty, \infty)$ which also is periodic in t with period T. This result is also extended (by the use of the Schauder fixed point theorem) to the case with nonlinear right hand side and the case with nonlinear data on the boundary. In the linear case, uniqueness is established. In the nonlinear case, uniqueness is obtained only if stronger conditions are imposed on the nonhomogeneous terms. Dissert. Abstr.

N69-10074 Cincinnati Univ., Ohio.
A STABILITY AND PERIODICITY ANALYSIS OF A SPECIAL HILL'S EQUATION
Keppel Duane Wait (Ph.D. Thesis) 1967 152 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-2026

The special Hill's differential equation, $d^2y/dx^2 + M(x)y = 0$, was investigated, where $M(x) = \alpha(x-nT)$; $nT - \epsilon \leq x \leq nT + A - \epsilon$ and $\gamma(x-nT)$; $nT + A - \epsilon < x < (n+1)T - \epsilon$ for n an integer, T and A parameters, and ϵ a positive constant smaller than A. The $y_1(x)$ and $y_2(x)$ solutions satisfying the normalizing initial conditions, $y_1(0) = 1 : y_2(0) = 0 : y_1(0) = 0 : y_2(0) = 1$ were constructed in functional form. From these solution forms it was possible to obtain relations connecting the parameters which force y_1 and y_2 to be stable. In addition, other parametric relations were obtained which, when satisfied, cause y_1 and y_2 to have a period equal to nT for n any positive integer. Dissert. Abstr.

N69-10119*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
ANALYSIS AND DESIGN OF INTEGRATION FORMULAS FOR A RANDOM INTEGRAND
J. S. Lee and Y. C. Ho Aug. 1968 40 p refs
(Grant NGR-22-007-068)
(NASA-CR-97476; TR-2) Avail: CFSTI CSCL 12A

In this report, an analysis of known integration formulas under random circumstances are presented and a procedure for designing an optimal integration formula which takes advantage of the statistical knowledge of the integrand is developed. The optimal integration formula of a different degree is chosen according to the capacity of the onboard computer and the required output frequency of the integrated value of the integrand. It is shown that a higher degree optimal integration formula which carries less of a computational load can be effectively derived from the second degree optimal integration formula. This will reduce the computational complexity necessary for obtaining the optimal coefficients of a higher degree integration formula on an off-line computer. To

overcome the difficulty of implementing the time varying coefficients of an integration formula, a method is developed for designing the constant coefficient suboptimal integration formula. Computational results obtained by applying these integration formulas show significant improvement over those obtained by using conventional integration rules. Author

N69-10184 State Univ. of Iowa, Iowa City.
A STUDY OF DYNAMIC SYSTEM PARAMETER ESTIMATION BY CONTINUOUS METHODS OF STEEP DESCENT
Richard Elgar Rose (Ph.D. Thesis) 1967 143 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-972

A study of the "output error" method for automatically determining the parameters of a physical system is presented. The method operates by a direct comparison of the response of the physical system to that of an assumed mathematical model. The error between the model and the physical system is then used to automatically determine the parameters in the model which minimize some preselected error criterion. A method of steep descent is used to define the parameter adjustment. An improvement in the operation of the method is shown by using an error criterion that is quadratic and positive definite in the parameter space. For a single sinusoid input, the error surface can be made invariant by the use of a specific weighting matrix in the quadratic error criterion such that the parameter oscillations and escalloped search pattern are removed. Dissert. Abstr.

N69-10241 Illinois Univ., Urbana.
SOME ASPECTS OF ABSTRACT LINEAR EVOLUTION EQUATIONS IN HILBERT SPACE
Jeffery Mackenzie Cooper (Ph.D. Thesis) 1967 143 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-1727

Equations of the form $d/dt\ u + A(t)u = f$ are considered where A(t) is a family of unbounded operators in a separable Hilbert space H, depending on a real parameter t in a finite interval [0,T]. u and f are functions of t taking values in H. The derivative is taken in the sense of a distribution on (0,T) with values in H. Dissert. Abstr.

N69-10242 Minnesota Univ., Minneapolis.
TENSOR PRODUCTS OF BANACH-*-ALGEBRAS
Kjeld Bagger Laursen (Ph.D. Thesis) 1967 97 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 67-17282

The present work deals with tensor products of Banach-*-algebras with involution. Taken as a whole the paper may be considered an investigation of the extent to which certain properties of Banach algebras are passed on to their tensor products. The work is divided into four parts. In the first of these much of the background material needed throughout the paper is presented. The paper introduces the basic notion of a tensor product of algebras, indicates how this tensor product may be normed and made into an algebra and then proceeds to describe the representation theory needed. Included in this is the introduction of the enveloping algebra of a Banach-*-algebra. Dissert. Abstr.

N69-10247 Wisconsin Univ., Madison.
PRIORITY QUEUES: ANALYSIS, OPTIMIZATION AND BEHAVIOR OF MEAN WAITING TIME IN SINGLE-SERVER SYSTEMS
Oscar Heriberto Barros (Ph.D. Thesis) 1967 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 67-12105

The research reported in this dissertation has two main objectives. First, to study the problem of optimal priority assignment in single server queuing systems with a fixed number of priority classes and to provide means for finding such an assignment as well as the corresponding optimal mean waiting time. Here, the optimal priority assignment is understood to be a way of allocating customers to classes, based on service time, that minimizes their stationary mean waiting time. The second objective is to analyze the numerical behavior of the optimal mean waiting time. The mean waiting times when applying the first come, first served discipline and the shortest operation rule are taken as references in this analysis. In carrying out the analysis, the number of classes and the parameters of the system distributions are used as variables. This is aimed at determining the factors that affect the mean waiting time reduction due to replacing a first come, first served discipline by the priority rules considered here. Dissert. Abstr.

N69-10280 Princeton Univ., N. J.
COMPARISON AND FINITENESS THEOREMS FOR RIEMANNIAN MANIFOLDS
Jeff Cheeger (Ph.D. Thesis) 1967 75 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-2465

Several theorems, and their proofs, are presented to extend Ambrose's isometry theorem to a comparison theorem Dissert. Abstr

N69-10333*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
AN INVARIANCE PRINCIPLE FOR DYNAMICAL SYSTEMS IN HILBERT SPACES
M. Slemrod and E. F. Infante [1968] 7 p refs
(Grants NGR-40-002-015; NSF GP-9024; DA-31-124-ARO(D)-270)
(NASA-CR-97451) Avail: CFSTI CSCL 12A

A new concept of a weak dynamical system is used to extend the second method of Liapunov to a distributed parameter system. This approach uses an invariance principle to weaken the hypotheses of Liapunov's theorems for autonomous systems in finite dimensions. G. G.

N69-10385 Cornell Univ., Ithaca, N. Y.
PLASTIC ANALYSIS AND MATHEMATICAL PROGRAMMING
Dirk Cornelis Adriaan Koopman (Ph.D. Thesis) 1967 88 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-661

It is shown how an approximate solution to two and three dimensional limit analysis problems may be found by their formulation as mathematical programming problems on the basis of the lower or upper bound theorems. A mathematical programming problem is one in which a generally nonlinear function of several variables is to be optimized with the variables subject to a set of generally nonlinear equality and/or inequality constraints. The numerical solutions to these problems may subsequently be found by means of appropriate algorithms. Questions of theoretical validity and some aspects of convergence are discussed. Results of specific lower and upper bound examples are presented and computational aspects are discussed. The method is quite general, yet application is relatively simple and results appear to be accurate for the linear programming approximations investigated. A high-speed digital computer and coded programming algorithms are indispensible for practical use of the method. The only limitation is the size of the available facility. Dissert. Abstr.

N69-10603# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT THE SOLUTION OF PROBLEMS ON UNIVERSAL CALCULATING SYSTEMS [O RESHENII ZADACH NA UNIVERSALNYKH VYCHISLITELNYKH SISTEMAKH]
E. V. Yewreinov et al. 12 Jan. 1968 78 p refs Transl. into ENGLISH from Vychislitel'nyye Sistemy. AN SSR, Sibirsk. Otd. Inst. Mat. no. 17, 1965 p 106–164
(AD-674310; FTD-MT-24-335-67) Avail: CFSTI CSCL 12/1

The feasibility of the efficient solution of problems on universal computer systems with a large number of machines has been investigated. For that purpose the paper presents 16 types of problems covering the basic fields of mathematics. The problems were solved with the help of the best-known methods for their solution. The paper gives the estimate of the number of cycles needed for the solution of each of the particular problems and the necessary memory volume. For each type of problem, the logical scheme of the algorithm is also found, described by means of the P-language. Simultaneously, for each of the problems one searches for such a number $k > 1$ of machines entering into the universal computer system that the problem is solved on such a system k times faster than on a single machine. It is assumed that each machine entering into the universal computer system has a set of operations determined by the totality of problems which are being solved. TAB

N69-10620# Oak Ridge National Lab., Tenn.
ALGORITHM FOR INITIAL VALUE PROBLEMS
Donald W. Altom and William L. Morris Aug. 1968 39 p refs
(Contract W-7405-ENG-26)
(ORNL-4282) Avail: CFSTI

A new variable step algorithm for the numerical solution of systems of first order ordinary differential equations is presented. The algorithm has been coded as a FORTRAN subroutine and is available in the ORNL Subroutine Library as subroutine number D02013. Author (NSA)

N69-10718# California Univ., Berkeley. Lawrence Radiation Lab.
BOUNDS FOR ROOTS OF CERTAIN POLYNOMIALS AND MATRICES
Harold Hanerfeld Jun. 1968 17 p refs
(Contract W-7405-ENG-48)
(UCRL-18267) Avail: CFSTI

Bounds for the roots of polynomials and matrices are sought. A number of such bounds are found for the case where the polynomial has only positive roots. A lower bound for the magnitude of the least root of an arbitrary real polynomial is obtained. By considering matrices in tri-diagonal form, the bounds are extended to matrices. Finally some bounds are given for the least root of a positive definite matrix, depending only on the matrix elements. Author (NSA)

N69-10738# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
ON THE METHOD OF STEEPEST DESCENTS
V. A. Kolkunov, N. N. Meiman, E. S. Nikolaevskii, and V. N. Petrukhin 1967 24 p refs In RUSSIAN; ENGLISH summary
(ITEF-561) Avail: Issuing Activity

Formal expansions of contour integrals using the saddle point method are investigated. All the terms of the saddle point series are obtained in the explicit way through the integrand function. To expand the class of calculated contour integrals, a modified saddle point method is proposed which takes into account singularities closest to the dependence region of a saddle point. Convergence and applicability of the saddle point when the large parameter is absent are discussed by specific examples. The application of the modified saddle point method to the calculation of the phase space volume is given in detail and the algorithm of the computer program is presented. Author (NSA)

N69-10740# California Univ., Berkeley. Div. of Applied Mechanics.
ON THE OBSERVABILITY OF LINEAR TIME-INVARIANT SYSTEMS WITH UNKNOWN INPUTS
Giuseppe Basile and Giovanni Marro Jul. 1968 15 p refs
(Contract Nonr-3656-(31))
(AD-675054; AM-68-8) Avail: CFSTI CSCL 12/1

The paper deals with the observation of linear time-invariant dynamical systems in the general case where some of the input functions are not known. By means of arguments based on the concepts of controlled and conditioned invariants, we find a convenient expression for the observability subspace, which subsumes the well-known expression for the case where the input functions are given. Author (TAB)

N69-10854# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
A NOTE ON LINEAR PROGRAMMING AND INTEGER FEASIBILITY
Fred Glover (Tex. Univ., Austin) Aug. 1968 11 p refs
(Contract Nonr-760(24))
(AD-675499; RR-127) Avail: CFSTI CSCL 12/2

A theorem is given that provides new strategies for solving integer programming problems, based on finding certain types of basic solutions to linear programs. The theorem is motivated by and extends ideas of Cabot and Hurter. An integer programming method based on the theorem is outlined. Author (TAB)

N69-10954# National Aerospace Lab., Tokyo (Japan).
ON APPROXIMATIONS FOR NONLINEAR CAUCHY PROBLEMS IN LOCALLY CONVEX SPACES
Kiyofumi Kojima 1968 9 p refs In JAPANESE; ENGLISH summary
(NAL-TR-158) Avail: CFSTI

Let X be a locally convex linear topological space such that each closed bounded set is complete and sequentially compact, and consider the initial value problem in X: $du(t)/dt = Au(t)$, where A is a nonlinear continuous operator on X. In this paper, we are concerned with an approximation for the above equation for a continuous operator on X. Author

N69-11019# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ONE CLASS OF ELEMENT SELECTION ALGORITHMS FROM A FINITE SET
Yu. I. Zhuravlev 27 Dec. 1967 14 p Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR (Novosibirsk), no. 2, 1964 p 28–36
(AD-675423; FTD-HT-23-1300-67) Avail: CFSTI CSCL 12/2

Let a table be given which is filled with sets of symbols of some alphabet. (For example, a dictionary or a table of the values of functions.) The problem arises to find a point in the given table on which the given set is written. The problem of looking for a word in the dictionary and the problem of finding the values of a function set by the table according to a given value of the argument, etc., are reduced to this problem. A trivial solution to this problem exists: it is possible to scan all sets of the table in succession and compare them with the given set until coincidence occurs. Such an algorithm is not very productive, especially in frequent selections. In the latter case it is possible to show a more rational method of inquiry based on a preliminary study of the given table. In the present report one class of algorithms of selection from the table is shown by an algorithm close to optimal among the algorithms of a given class. TAB

N69-11159# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
A PROCEDURE AND A FORTRAN-4 PROGRAM FOR THE SMOOTHING APPROXIMATION OF STEP FUNCTIONS THROUGH SMOOTH CURVES [EIN VERFAHREN UND EIN FORTRAN-4 PROGRAMM ZUR FLAECHENTREUEN APPROXIMATION VON TREPPENFUNKTIONEN DURCH GLATTE KURVEN]
H. Spaeth May 1968 28 p refs In GERMAN; ENGLISH summary
(KFK-738) Avail: CFSTI

When smoothing step functions, i.e., multigroup spectra, to a weighting function for the calculation of multigroup constants in neutron transport theory, the following problem arises: To a given step function a smooth curve is searched so that the areas below the curves are equal in each of the intervals defined by the discontinuities of the step function. A definition of smooth is given that has been proven to be a good one in practice. The approximation problem is formulated and a numerical method is given to calculate such a smooth and area-preserving curve. Propositions about the existence and uniqueness of such a function can only be made for trivial cases. Author (NSA)

N69-11266#
FINITE-DIFFERENCE SOLUTION OF THE NAVIER—STOKES EQUATIONS
L. M. Simuni [1968] 6 p refs Transl. into ENGLISH from the book "Sovremennye Voprosy Gidrodinamiki" Kiev, Naukova Dumka Press, 1967 p 344–351
Avail: CFSTI

Finite difference methods are used to solve approximate and complete Navier—Stokes equations. To demonstrate the applicability of the proposed approach the following are analyzed: (1) the problem of the mixing of plane, periodically disposed, laminar jets; and (2) the problem of viscous incompressible fluid motion in a plane, abruptly expanding channel. S.C.W.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N69-10116 Oregon State Univ., Corvallis.
CLOUD COVER AND INCOMING SOLAR RADIATION OVER THE EQUATORIAL PACIFIC
William Hewes Quinn (Ph.D. Thesis) 1968 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-857

Canton Island (at 2° 49'S, 171° 41'W) was selected to study equatorial trough weather conditions and their effects on incoming solar radiation. The chosen period of study (July 1957–June 1958) was highly applicable, since the mean position of the equatorial trough for this year was 4° south of its mean annual position and it frequently affected Canton. Extensive periods of fair weather at the trough axis and in its immediate vicinity (within 3°), showed that there was no substantiation for the assumption of continuous convergence or routine disturbance type weather in the so-called intertropical convergence zone. Only one out of five days, on the average, was affected by disturbance-type weather in the immediate vicinity of the trough axis. The overall average solar radiation transmission percentage, for disturbance situations within 3° of the trough axis, was 34.6; whereas, during fair weather, within 3° of the trough axis, the overall average transmission percentage was 61.3. Dissert. Abstr.

N69-10129 Kansas Univ., Kansas City.
SPATIAL AND TEMPORAL VARIATIONS OF THE DIURNAL DISTRIBUTION OF TORNADOES IN THE UNITED STATES
Richard Henry Skaggs (Ph.D. Thesis) 1967 165 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-835

Details are given on an investigation designed to determine for the eastern and central United States: (1) whether there are spatial variations in the diurnal distribution of tornadoes, (2) whether there are diurnal distribution types, and (3) whether reasonable hypotheses for why the spatial patterns exist can be formulated. A series of analyses were performed on histograms of the diurnal distribution of tornadoes. The major conclusions reached are as follows: (1) There is much greater variation in the diurnal distribution of tornadoes than has been previously recognized. (2) The three major diurnal distribution types are organized into spatial units which suggest spatial variations in tornado and tornado-related processes. (3) The traditional concept of the shape of the diurnal curve of tornado occurrences is valid for about 2/3 of the central and eastern United States. (4) Interhourly variation is considerable for the remaining 1/3 of the study area and multimaximal distributions are not uncommon. (5) Secondary maxima are common and distinctive even if a well-developed primary maximum exists. (6) No explanation of the spatial and temporal variations described can be provided on the basis of present knowledge. Dissert. Abstr.

N69-10185# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
FOG DISSIPATION USING A CARBON DIOXIDE LASER
G. J. Mullaney, W. H. Christiansen, and D. A. Russell Aug. 1968 13 p refs
(D1-82-0745) Avail: Issuing Activity

Laboratory measurements have been made of the evaporation rate of fog when subjected to an intensity of 5 to 50 W/cm^2 of 10.6μ radiation. The measurements agree with calculations and show that most of the absorbed laser energy goes into heating the air by conduction from the droplet surface. This heated air induces a motion which prevents the laser from completely clearing the fog. A correlation is found which describes the visibility improvement as the fog and power density are varied. Author

N69-10238# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
EVALUATION OF UTILITY OF ANNOTATED WEATHER OUTLINES Interim Report
William Lewis Nov. 1968 31 p refs
(NA-68-43; RD-68-54) Avail: Issuing Activity

Simulations were carried out using two methods of presenting the NAS En Route Stage A Model 1 Weather Outline (WOG) radar weather contours on air traffic controllers' displays. The first was the televising of a series of manually prepared displays consisting of annotated dot (outer) and X (inner) WOG contours. The annotations consisted of simulated reports of storm heights, turbulence and hail. The second was through digital recordings of the digital radar channel method of presenting contours wherein three radar antenna sweeps build up the dotted outline, three the X outline and so on cyclically. Using rules based on severe storm research, 17 controllers vectored aircraft around the televised weather displays during simulations. Eleven of the controllers observed the radar channel three-sweep display but did not use it for vectoring. Most controllers stated that the dark televised display provided sufficient definition for vectoring and was an improvement over conventional CP "punch-through." Author

N69-10239# Weather Bureau, Silver Spring, Md. Techniques Development Lab.
METEOROLOGICAL ANALYSIS OF 1964–65 ICAO TURBULENCE
DeVer Colson Oct. 1968 84 p refs
(WBTM-TDL-14) Avail: CFSTI

Summaries are given of clear air turbulence (CAT) data over Alaska, Canada, Greenland, North Atlantic, Caribbean, Mexico, and Central America during four 5-day periods (December 1964, March, June, and September 1965) in the ICAO worldwide high-level turbulence collection program. Turbulence reports are summarized by intensity, altitude layer (<30,000, 30,000–33,999 ≥34,000 ft.), and location by 5-degree latitude-longitude square. Meteorological analyses are presented showing probability of moderate or greater turbulence in relation to 300-mb circulation patterns, jet streams, isotachs, horizontal wind shear, and contour gradients. While no sharply defined criteria are established for routine prediction of occurrence of intensity of CAT, some interesting meteorological patterns associated with unusually turbulent conditions are shown. The study illustrates the importance of large values of wind speed, wind shear, and contour gradients and also rapidly increasing values of these parameters. The study particularly shows the importance of sharply curved flow patterns around troughs and ridges. Author

N69-10328# Weather Bureau, Silver Spring, Md. Techniques Development Lab.
PREDICTION OF TEMPERATURE AND DEW POINT BY THREE-DIMENSIONAL TRAJECTORIES
Ronald M. Reap Oct. 1968 24 p refs
(WBTM-TDL-15) Avail: CFSTI

A numerical model is developed to compute three-dimensional trajectories from operational wind forecasts generated by the six-layer primitive equation model of the National Meteorological Center. Detailed forecasts of temperature and dew point, designed for application to severe storm prediction, are subsequently derived by computing the six-hourly variations of potential temperature and mixing ratio for air parcels assumed to follow paths defined by the trajectories. Initial values at the trajectory origin points are provided by an objective analysis technique which is capable of reproducing detailed patterns and gradients with only light smoothing of the observations. The influence of a relatively detailed terrain is also included in the program. Verification statistics for 74 test cases run during May–July 1968 indicate a significant improvement over the primitive equation model forecasts in the lowest 150 mb, where temperature and moisture distributions are crucial to severe storm development. Good agreement was also observed between the forecast dew point gradients and severe weather as viewed by the ESSA 3 satellite. Author

N69-10395# San Jose State Coll., Calif. Dept. of Meteorology.
WIND PROFILES IN WEST COAST TEMPERATURE INVERSIONS. LAND-SEA BOUNDARY EFFECTS ON SMALL-SCALE CIRCULATIONS
Albert Miller Mar. 1968 59 p refs
(Grant NSF GP-4248)
(Rept.-4) Avail: Issuing Activity

Examples of wind profiles in the vertical, cross sections, and trajectories of constant-volume balloons observed within the elevated west coast temperature inversion over the San Francisco Bay area are presented. Measurements were made with an instrumented aircraft and an automatic tracking radar. Wind profiles are very similar to those observed in ground based inversions elsewhere: there is normally a wind speed minimum near the base of the inversion and a maximum near the top that frequently takes on the appearance of a jet. The nose in the profiles and the strong shear in the inversion layer appear to be associated with a strong horizontal temperature gradient created in the trough of inversion height that normally lies near and parallel to the coastline. The wave is induced by differential heating between land and sea and partially by topography. Although there is no direct dynamic connection between the flow within the marine air and that in the warm, dry air aloft, low-level horizontal divergence that causes changes in the depth of the layer of marine air in turn affect the wind profile within the inversion layer. Author

N69-10430# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
SOME EARLY PHILADELPHIA, PENNSYLVANIA TEMPERATURE RECORDS. REPORT 1, ON A PROJECT STUDYING CLIMATIC CHANGES
H. E. Landsberg Aug. 1967 23 p refs
(Grant NSF GA-1104)
(TN-BN-495) Avail: Issuing Activity

Two early series of daily temperature observations made near Philadelphia, Pennsylvania, were reevaluated. The first covers not quite a year from November 1731 to November 1732. The second has data from August 1748 to January 1750. Monthly mean values were derived, which look quite reasonable compared with modern observations. A translation of the latin text in which the first series appeared is appended. Author

N69-10461# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
COMPUTATION OF HEIGHT AND VELOCITY OF CLOUDS FROM DUAL, WHOLE-SKY, TIME-LAPSE PICTURE SEQUENCES
Dorothy L. Bradbury and Tetsuya Fujita Mar. 1968 20 p refs
(Grants NSF GA-864; CWB-WBG-34)
(SMRP-70) Avail: Issuing Activity

This paper describes the techniques used for calibrating the whole-sky mirror and the computation of the cloud height and motions from time-lapse moving pictures taken with whole-sky cameras. The photographic cloud data were obtained with a camera network of stations atop the northern rim of Haleakala on the island of Maui during operations from 13 March through 3 April 1967. Three different camera systems were used: two stationary wide-angle movie cameras, two panoramic cameras, and two whole-sky cameras. When used as a stereo pair, whole-sky cloud pictures were found to be useful for studying cloud motions and heights; but to obtain reliable results it was found to be essential to calibrate accurately an image from each of the cameras. A very accurate calibration method proved to be the use of the subpolar point track on the whole-sky image. K.W.

N69-10562# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
PRELIMINARY RECONSTRUCTION OF A LONG TIME SERIES OF CLIMATIC DATA FOR THE EASTERN UNITED STATES
H. E. Landsberg, C. S. Yu, and Louise Huang Sep. 1968 31 p refs
(Grant NSF GA-1104)
(BN-571; Rept.-2) Avail: Issuing Activity

A number of scattered early U. S. climatological records prior to 1820 were re-evaluated. These, together with the more plentiful later data, were used to reconstruct a synthetic series for Philadelphia, Pa., from 1738 to the present. In the reconstruction, regressions obtained for the normal period 1931–60 were used. A partial statistical analysis for the temperature values discloses that the annual as well as the seasonal series are normally distributed and display the character of a reasonably homogenous, stationary time series. A long term trend is present but it is not yet determined if urbanization has had an influence. Variance spectra show a peak corresponding to the sunspot rhythm in the

annual and summer series. A peak in the annual, spring, and summer series correspond to an 8-year cycle recently discussed for Central Europe. The quasi-biennial pulse is present in the annual and all seasonal series. Author

N69-10635# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Labs.

A PHYSICAL MODEL OF CIRRUS 8–13 μ INFRARED RADIANCE

Freeman F. Hall, Jr. Jun. 1968 30 p refs *Its* Res. Commun. No. 66

(AD-674749; Douglas Paper-5171) Avail: CFSTI CSCL 4/2

A simplified physical model of cirrus cloud 8-13 micro meter radiance is derived in an attempt to explain measured cloud radiance characteristics. Thermal emission and scattering of irradiance from the earth are considered separately. The scattering diagram for a 50 micro meter radius ice sphere, which is opaque at these wavelengths, is computed from diffraction theory and specular surface reflection. Thermal emission is found to exceed scattered radiance significantly for all zenith angles, and computed radiance values are found to match measured cloud radiance closely. Author (TAB)

N69-10649# RAND Corp., Santa Monica, Calif.

WEATHER MODIFICATION PROGRESS AND THE NEED FOR INTERACTIVE RESEARCH

Oct. 1968 93 p refs

(Grant NSF C-415)

(RM-5835-NSF) Avail: Issuing Activity

The status of weather modification research is reviewed, with emphasis on progress since 1966. It is stressed: (1) The possibility of inadvertent weather or climate modification is rapidly becoming a probability, as human effects on the atmosphere and the surface of the planet grow at an increasing rate. (2) Progress in weather modification research continues to be hampered by the prevalent lack of cohesive effort by both theoreticians and experimenters. (3) Computers of advanced design and increased capacity will handle atmospheric models of considerably greater sophistication than in the past. (4) This is a not-to-be-neglected opportunity for interactive research—constant two-way feedback from theory to experiment to theory, with dynamic atmospheric models facilitating each advance. General and specific recommendations are appended concerning areas most urgently requiring research and instrumentation most drastically needing development. Author

N69-10686# National Severe Storms Lab., Norman, Okla.

OBJECTIVE DETECTION AND CORRECTION OF ERRORS IN RADIOSONDE DATA

Rex L. Inman Jun. 1968 56 p refs

(ERLTM-NSSL-40) Avail: CFSTI

Procedures employed at the National Severe Storm Forecast Center for detecting and correcting gross errors in radiosonde data are described. The results indicate that about 75% of the errors and/or deficiencies that are found are normally corrected. In most of the remaining cases nothing can be done because of too much missing data; this problem usually is caused by errors in the coding of the information. Author

N69-10805# Weather Bureau, Silver Spring, Md. Techniques Development Lab.

OBJECTIVE VISIBILITY FORECASTING TECHNIQUES BASED ON SURFACE AND TOWER OBSERVATIONS

Donald M. Gales Oct. 1968 32 p refs

(WBTM-TDL-16) Avail: CFSTI

Three objective techniques are presented for forecasting the morning minimum visibility at Washington National Airport in the fall season. Excluded from forecasts are dates with precipitation or a frontal passage before 1200Z. The basic technique makes use of the 0400Z wind speed and dew-point depression at Washington; the wind speed, wind direction, and wind gustiness recorded on a 300-ft tower; and a simple yes-or-no forecast for any clouds below 7500 ft before 1200Z. Gustiness is measured by the wind direction variability occuring in five classes. Three years of data provide the developmental sample. Verification statistics from an independent two-year sample show 68 percent of the forecasts in the correct class and a skill score of .40, slightly exceeding the skill of the official forecast. An alternate second technique uses only surface data from which tower data are objectivaly estimated; an alternate third technique employs only wind speed and dew-point depression to forecast visibility from isopleths. Author

N69-10951# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METEOROLOGICAL CONDITIONS OF AIRCRAFT LANDING

N. K. Sachkov 15 Dec. 1967 29 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 68, 1965 p 3–24

(AD-674891; FTD-MT-24-322-67) Avail: CFSTI CSCL 4/2

A procedure is given for determining the occurrence of minimum visibility and ceiling. The procedure is based on the relationship between the minimum height of the cloud bottoms and the landing (inclined) visibility. The bad weather was analyzed in several regions: the visibility of less than 2000 m and/or a ceiling of less than 200 m. The reproducibility of bad weather follows a definite path with the maximum occurring in the cold time of the year. The number of bad weather hours decreases from west to east. An attempt was made to relate the occurrence of bad weather to some synoptic-aerological factors such as fronts, anti-cyclones and sporadic winds. The proposed method of a climate approach to the occurrence of combined visibility and cloud height furnishes an average as well as the extreme number of hours of minimum weather at the given station. In turn, such data permit calculation of the probable working time of the airport per month, season, or year. The number of stand-by airports needed for the times of bad weather can also be determined. Author (TAB)

N69-10988# Deutscher Wetterdienst, Offenbach Am Main (West Germany).

FREQUENCY DISTRIBUTION OF CLIMATOLOGICAL FACTORS (TEMPERATURE, WIND, PRECIPITATION, AND CIRCUMGLOBAL RADIATION) AS OBSERVED AT FRANKFURT/MAIN AND VICINITY [HAEUFIGKEITSVERTEILUNGEN KLIMATOLOGISCHER GROEBEN (TEMPERATUR, WIND, NIEDERSCHLAG UND ZIRKUMGLOBALSTRAHLUNG) AM BEISPIEL VON FRANKFURT A. M. UND DESSEN NAEHERER UND WEITERER UMGEBUNG]

Heinz Wechter 1968 39 p refs In GERMAN; ENGLISH summary *Its* Rept. of the Ger. Weather Bur., vol. 15, no. 107

Avail: CFSTI

In addition to daily minimum, mean, and maximum air temperatures, the deviations of these values from their climatological means are considered. Time integrals of the deviations show L-shaped distributions, slightly varying through the seasons. The interdiurnal changes of the characteristic temperatures correlate with their preceeding deviations, again in a seasonally defined manner. The vector quality of the wind requires two-dimensional frequency distributions. Normal elliptical distributions result for the 700-mb and higher level winds. The vectorial changes at upper air winds show circular distributions. Precipitation at a certain moment is quantitatively characterized by the number of stations in a given network reporting concurrently. The frequency distribution of such events of concurrent precipitation is binomial for large observation areas and U-shaped for small ones; the difference is due to synoptic causes. The circumglobal radiation (where "circumglobal" refers to the point of observation) is measured by a Belleni-type ball pyranometer. The effects of station elevation on amount and yearly trend of the daily radiation sums is pointed out. K.W.

N69-10989# Deutscher Wetterdienst, Offenbach Am Main (West Germany).
REGIONAL PHENOLOGICAL AVERAGES FOR THE GERMAN FEDERAL REPUBLIC [PHAENOLOGISCHE GEBIETSMITTEL FUER DIE BUNDESREPUBLIK DEUTSCHLAND]
Erika Freitag 1967 84 p refs In GERMAN; ENGLISH summary *Its* Rept. of the Ger. Weather Bur. vol. 15, no. 108
Avail: CFSTI

Phenological regional means have been calculated from observation in the vicinity of 11 German climatological stations. These means at first concern 14 corn and 8 root crop phases as well as first meadow cut and apple blossom from 1947 to 1966. The attached tables contain for each individual region and vegetational year 24 phenological phases and 17 phenological time spans with their variations from 20-year mean values. The average, the earliest, and latest (shortest and longest resp.) phase and or time-span regional means of the period are given in tables. The material, listed according to regions, individual years, and seasonal course of vegetation, may serve as a basis for phenological-climatological investigations as well as agrometeorological reports and forecasts in the Federal Republic. Author

N69-11040# Deutscher Wetterdienst, Offenbach Am Main (West Germany).
STANDARD VISIBILITY AND TURBID AEROSOL EXCHANGE AT QUICKBORN/HOLSTEIN [UEBER DIE NORMSICHT BEI QUICKBORN/HOLSTEIN UND DEN AUSTAUSCH VON TRUEBENDEM AEROSAL]
Ernst Frankenberger 1967 24 p refs In GERMAN; ENGLISH summary *Its* Rept. of the Ger. Weather Bur., vol. 15, no. 106
Avail: CFSTI

Records of the standard visibility at Quickborn from summer 1965 have been analyzed with the following results: (1) by eliminating the influence of relative humidity on the standard visibility there results a random distribution of the logarithmic values, the standard deviation of which is about 0.7 of the original standard deviation; (2) the rate of wash-out by rainfall was about 14% of the turbid atmospheric aerosol per mm rainwater; (3) during the weekends with no rainfall about 36% of the aerosol content fell out until 17 o'clock on sundays; (4) the soil is a source of turbid aerosol with a production rate of about 14% of the aerosol content of the atmosphere per day; industrial production in the surroundings contributes about 17% per day; (5) from 3 to 6 o'clock a. m. the sedimentation of aerosol particles is much higher than during the first part of the night; (6) considering the wind dependency of the standard visibility it is concluded that about 10% to 20% of the aerosol particles have maritime origin, if the wind at Quickborn blows from the North Sea and if its velocity is stronger than 10 m/s. Author

N69-11151# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
SIXTH ANNUAL METEOROLOGICAL DATA OF THE CASACCIA NUCLEAR STUDIES CENTER, 1967 [VI ANNUARIO METEOROLOGICO DEL CENTRO STUDI NUCLEARI DELLA CASACCIA, 1967]
P. Cagnetti, C. Fienghi, G. Giudici, and V. Martinelli 1968 114 p In ITALIAN
(RT/PROT(68)13) Avail: CFSTI

Meteorological data for Casaccia, Italy, from 1 December 1966 to 30 November 1967, are presented by tables and graphs. Included are: (1) temperatures, (2) precipitation, (3) humidity, (4) wind, and (5) atmospheric pressure. Transl. by F.O.S.

N69-11278# Joint Publications Research Service, Washington, D. C.
DESTRUCTION OF DEVELOPING CUMULUS CLOUDS BY ARTIFICIALLY CREATED DESCENDING CURRENTS
N. I. Vul'fson et al 21 Oct. 1968 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 181, no. 4, 1968 p 855-857
(JPRS-46716) Avail: CFSTI

When artificial downward-directed velocity impulses within cumulus clouds were created by the flight of jet aircraft at large pitching angles, the clouds decayed into parts and their upper boundary dropped considerably or they disappeared completely with 5 min after the flights. More strongly developing clouds were destroyed more rapidly and to a greater extent. It has been previously demonstrated that both ascending and descending stationary currents can arise spontaneously in unstable atmospheric layers; and tabulated data indicate that the finite velocities of the descending currents are either the same or exceed those in ascending currents. M.W.R.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N69-10056*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
INFLUENCE OF ANGLE OF GLIDE SLOPE ON THE ACCURACY OF PERFORMING INSTRUMENT APPROACHES IN A SIMULATOR
Lindsay J. Lina and George C. Canavos Washington Nov. 1968 44 p refs
(NASA-TN-D-4835) Avail: CFSTI CSCL 17G

A simulator study was made to determine the effect of glide slope angle on the accuracy of performing a landing approach and a go around. Statistical evaluation of the data indicates that the angle of glide slope had no appreciable effect on the accuracy of approach but had an influence on the minimum altitude in the missed approach maneuver. The probability of completing a landing without excessive maneuvering in the last few seconds of flare is reduced by a varying cross wind. Author

N69-10069*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
COMPARISON OF INFORMATION DISPLAY CONCEPTS FOR LANDING OF VTOL AIRCRAFT
William Gracey Washington Nov. 1968 44 p refs
(NASA-TN-D-4861) Avail: CFSTI CSCL 17G

A variety of instrument displays for the landing of VTOL aircraft are described. The displays are classified in terms of basic concepts for the presentation of attitude and guidance information. The concepts range from the simple display of vertical- and horizontal-situation information to the more complex combination of attitude and guidance information in perspective form. The information elements of the displays are presented either in abstract form or with varying degrees of realism. Guidance information is combined as flight-director commands in some displays and as pictorial presentations in others. Tests of those displays that have been evaluated either in simulators or in flight are discussed. The review of these tests shows that the only display with which VTOL landings have been achieved in flight (under simulated zero-zero conditions) is the real-world display of a closed circuit television system. A televised display of a simulated real-world landing site is therefore suggested as a possible form of display for achieving VTOL landings under zero-zero conditions. Author

N69-10272# Federal Aviation Agency, Atlantic City, N. J. National Aviation Facilities Experimental Center.
COLLISION AVOIDANCE: A BIBLIOGRAPHY, 1955–SEPTEMBER 1968
Dorothy E. Bulford, comp. Nov. 1968 172 p refs
(NA-68-54) Avail: Issuing Activity

The Federal Aviation Administration is dedicated to providing a safe and efficient system for the utilization of national airspace. The prevention of mid-air collisions is a highly important aspect of overall FAA efforts. To assist both Government and the aviation industry in their study of collision avoidance matters, this bibliography was compiled. Author

N69-10372*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYTIC APPROXIMATIONS FOR APPLICATION TO SPACECRAFT OPTICAL NAVIGATION ON SHORT DATA ARCS
Alton P. Mayo and William M. Adams, Jr. Washington Nov. 1968 32 p refs
(NASA-TN-D-4863) Avail: CFSTI CSCL 17G

The standard least squares orbit determination procedures are simplified for application to a navigation system where position fixes are taken over a short trajectory arc. Basic assumptions used are as follows: (1) for small perturbations in spacecraft state, velocity deviations remain constant and position deviations increase linearly with time and (2) the sensitivity of the measurements to small spacecraft position changes remains constant over the trajectory arc. Simple analytic expressions are then derived for estimating the accuracy of the spacecraft position and velocity as a function of the number of fixes and the time span over which the fixes are made, or inversely the number of fixes and the time span over which they must be made for a prescribed position and velocity accuracy. For a large number of measurements the standard deviation of the position error was shown to vary inversely as the square root of the number of measurements, as expected, and the standard deviation of the velocity error was shown to vary inversely as the product of the square root of the number of measurements and the time span over which the measurements are made. Simplified equations are also derived for determining the orbit (state) of the spacecraft. Author

N69-10679*# General Electric Co., Pittsfield, Mass. Ordnance Dept.
OPTIMUM DIGITAL FILTER STUDY FOR STRAPDOWN INERTIAL NAVIGATION SYSTEM INITIAL ALIGNMENT Final Report, 8 Jan. 1968–8 Jul. 1968
8 Jul. 1968 100 p refs
(Contract NAS8-21273)
(NASA-CR-98101; OD-68-41) Avail: CFSTI CSCL 17G

An assessment is made of digital methods for recovering the initial misalignment of a strapdown inertial navigation system from vibration- and sway-corrupted data on the launch pad. The methods considered include an optimal Kalman-type filter, a simplified Kalman filter, a maximum likelihood approach, and a least squares curve fit technique with and without preconditioning of the data. Equations are derived for the filter analyses, along with the equations for the erection and alignment simulation program. Based on performance, the optimal 4-state filter (simplied Kalman) is recommended. If pad computer capacity becomes a limiting factor, the linear least squares filter using nonintegrated data is the recommended approach. Summary information is provided on the computer requirements for solving the filter and azimuth alignment equations for the two recommended filters. Data are also included on the terms which must be filtered out of a strapped down accelerometer output in a swaying missile in order to determine the accelerometer orientation; optical alignment equations; and a closed form solution of the least squares curve fit filter equations. M.G.J.

N69-11120# Pickard and Burns Electronics, Waltham, Mass.
VLF AIRBORNE SYSTEM NOISE AND ANTENNA STUDY AND STUDY OF LANE IDENTIFICATION FOR OMEGA, VOLUME 1 Final Report, 18 Jun. 1965–31 Dec. 1967
Richard H. Woodward, Morton F. Spears, Bernard Ambroseno, and David Davidson (DECO, Westinghouse) 4 Mar. 1968 132 p ref
(Contract FA-65-WA-1298)
(AD-675504; P/B-979-8-VOL-1; RD-68-17) Avail: CFSTI CSCL 17/7

The immediate purposes of the program are to determine the effect of precipitation static on the reception in aircraft of very-low-frequency signals, to devise a method for reducing the effect to a tolerable level and to collect data on Omega, and ultimately to determine the feasibility of Omega for air navigation. Three types of airborne antennas have been investigated. Phase-difference and field-intensity data were collected over periods of approximately three days and three nights in winter and summer at six widely scattered monitor stations (airports) in South America and six in North America. This information is needed for the accurate prediction of Omega sky-wave corrections, hyperbolic lines of position and lane identification. For the study of the propagation of Omega signals at relatively short range from the transmitting station, phase difference of Omega signals relative to a stable reference source were measured in a small truck travelling along the highways out to a range of 600 kilometers from the Forestport station. Author (TAB)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N69-10024 Stanford Univ., Calif.
A STUDY OF THE EFFECT OF RESONANCE WIDTH ON RESONANCE ABSORPTION OF NEUTRONS IN NUCLEAR REACTORS
Bryce Walby Johnson (Ph.D. Thesis) 1967 215 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 67-17443

The effect of the energy width of a given resonance relative to the energy loss by moderating collisions is investigated. The experiment consists of activating absorber materials (gold and thorium) by resonance-energy neutrons in a reactor core in the presence of different moderating materials to provide a wide variation in the relative resonance width. Activation rates in the presence of the different moderators are calculated by a successive-substitutions scheme developed for solving Chernick's integral conservation equation for the flux level in heterogeneous systems. The successive-substitutions method is valid for any relative width of resonance, and for either extremely wide or extremely narrow resonances it duplicates the results of the commonly-used approximations which are valid for these extreme cases. Calculated activation rates agree very well with the measured values. The successive-substitutions scheme evolved for predicting foil activation rates is applied to a reactor lattice for comparison with other techniques for evaluating resonance absorption. Dissert. Abstr.

N69-10036# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.
RESONANCE NEUTRON SPECTRUM OF REACTOR
I. Grancea, V. Cuculeanu, and Gh. Fratiloiu 1968 10 p refs
(IFA-FR-69) Avail: Issuing Activity

The resonance neutron spectrum was measured in the WWR-S reactor by the activation of foil resonance detectors and the cadmium-ratio method. The results were used to determine the spectral index r from Westcott's formalism and investigate the deviation of the spectral distribution from the 1/E law. NSA

N69-10067*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUCLEAR-ROCKET PROPULSION
Frank E. Rom Washington Nov. 1968 40 p refs
(NASA-TM-X-1685) Avail: CFSTI CSCL 21F

The three basic types of nuclear rocket powerplants (solid, liquid, and gas core) are compared. Solid core systems are expected to have specific impulses of 850 seconds with negligible fuel loss. The liquid core nuclear rocket will have a uranium loss rate of 0.01 to 0.1 mass unit per mass unit of hydrogen if specific impulses in the range of 1200 to 1500 seconds are desired. The gas core system will have similar loss rates of uranium but will produce specific impulses in the range of 1500 to 2500 seconds. Author

N69-10099*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
URANIUM DIOXIDE VENT LOSS IN AN EXTERNALLY FUELED THERMIONIC REACTOR CONCEPT
James J. Ward and Robert B. Ruch Washington Nov. 1968 21 p refs
(NASA-TN-D-4922) Avail: CFSTI CSCL 18J

An analysis of fuel losses through a fission gas vent in a nuclear thermionic reactor concept is presented. The converters are externally fueled with ceramic uranium dioxide (UO_2), and fuel losses during both steady-state operation and temperature excursions are estimated. Calculations were performed for element fuel-volume fractions of 0.275 and 0.55 with converter heat fluxes of 50 and 100 W/cm^2 at an emitter temperature of 2000°K. The absolute UO_2 loss during a temperature excursion and the ratio of UO_2 loss during an excursion to the yearly steady-state loss are presented as functions of time for each case. Author

N69-10131# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
EXPERIMENTAL CO-60 HEAT SOURCE CAPSULES
J. P. Faraci May 1968 19 p refs
(Contract AT(07-2)-1)
(DP-1145) Avail: CFSTI

Cobalt containing up to 280 curies of ^{60}Co per gram of metal was encapsulated in nickel- and cobalt-based superalloys. These experimental heat source capsules, producing up to 660 watts each, were prepared for testing at 850 to 1000°C for up to 10,000 hours. Author (NSA)

N69-10149# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.
ANALYSIS OF ARMF MEASUREMENTS BY ONE-DIMENSIONAL MULTIGROUP DIFFUSION CALCULATIONS
D. A. Millsap Jul. 1968 56 p refs
(Contract AT(10-1)-1230)
(IN-1067) Avail: CFSTI

Descriptions of the ARMF-I and ARMF-II core loadings for reactivity measurements are given. Experimental procedures are given. Calculational procedures are described; energy and lethargy group structures are listed. Normalized unperturbed real fluxes, adjoint fluxes, and absorption statistical weights are tabulated. Results of measured and calculated values are shown graphically. Group cross sections and reactivities are tabulated for water, heavy water, Be, C, Mg, Al, Zr, Pb, and Bi. NSA

N69-10161 Virginia Univ., Charlottesville.
DETERMINATION OF THE LUMPED HEAT-TRANSFER AND REACTIVITY COEFFICIENTS OF A NUCLEAR REACTOR
Mohamed Abel-Fattah Obeid (Ph.D. Thesis) 1967 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-17659

A method is presented for determining the lumped heat-transfer coefficients plus the temperature coefficients of reactivity of a nuclear reactor. No knowledge of the component temperatures is required, so that the method is particularly attractive in systems where temperatures cannot be monitored, or where uncertainties in temperature variations can produce large errors in experimental results. A mathematical model was developed for the reactor which was assumed to consist of lumped fuel, moderator, and reflector components. Equations were derived to permit an evaluation of the heat-transfer and temperature feedback coefficients, through a matching of the model to the frequency response, as obtained by pile oscillator techniques. Dissert. Abstr.

N69-10216*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ESTIMATION OF FISSION-PRODUCT GAS PRESSURE IN URANIUM DIOXIDE CERAMIC FUEL ELEMENTS
Walter A. Paulson and Roy H. Springborn Washington Nov. 1968 32 p refs
(NASA-TN-D-4823) Avail: CFSTI CSCL 18J

Fission-product gas pressure in macroscopic voids was calculated over the temperature range of 1000° to 2500°K for clad uranium dioxide fuel elements operating in a fast neutron spectrum. The calculated fission-product yields for uranium-233 and uranium-235 used in the pressure calculations were based on experimental data compiled from various sources. The contributions of cesium, rubidium, and other condensible fission products are included with those of the gases xenon and krypton. At low temperatures, xenon and krypton are the major contributors to the total pressure. At high temperatures, however, cesium and rubidium can make a considerable contribution to the total pressure. Author

N69-10311# Minnesota Mining and Mfg. Co., St. Paul, Minn. Space and Defense Products.
SNAP-21 PROGRAM, PHASE 2: DEEP SEA RADIOISOTOPE-FUELED THERMOELECTRIC GENERATOR POWER SUPPLY SYSTEM Quarterly Report, 1 Apr.–30 Jun. 1968
Jul. 1968 317 p (Contract AT(30-1)-3691)
(MMM-3691-35) Avail: CFSTI

The following items represent the significant accomplishments on the SNAP-21 Program during the past quarter: (1) four fuel capsules were prepared for fueling at Oak Ridge National Laboratory; (2) completed dynamic testing of insulation system B10D2; (3) completed insulation wrapping and thermal testing of insulation system B10Q1; (4) completed insulation wrapping of insulation system B10DL1; (5) the Preliminary Safety Analysis Report was completed and published; (6) an acceptance criteria specification for the power conditioners was prepared and released; (7) completed strength testing of Berylco pressure vessel material; (8) initiated fabrication of first system shipping container; (9) generator A10D8 was assembled and acceptance tested; (10) system S10D2 was assembled and put through the complete environmental sequence; and (11) the Thermoelectric Generator Performance Evaluation Report was completed and submitted. Author (NSA)

N69-10346# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
EXPERIMENTS ON THE THERMAL BOWING OF SINGLE RODS SUPPORTED AT SEVERAL AXIAL POSITIONS

A. C. Rapier and T. M. Jones 18 Mar. 1968 20 p refs
(TRG-Report-1662) Avail: CFSTI

Experiments to determine the change of shape of a single roughened rod supported with two or three equal-length spans are described. Separate experiments to determine the effect of rod displacement show that the coolant flow in the annular channel has a slight swirl. When this swirl is taken into account, the observed bowing is in good agreement with the theoretical predictions. Experiments in which this swirl is eliminated will provide more satisfactory confirmation of the theory. Author (NSA)

N69-10478# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik.

INFLUENCE OF THE INTERNAL GEOMETRY ON THE RADIAL TEMPERATURE DISTRIBUTION OF FAST BREEDER FUEL ELEMENTS [EINFLUSS DER INNEREN GEOMETRIE AUF DIE RADIALE TEMPERATURVERTEILUNG VON SCHNELLBRUETER-BRENNELEMENTEN]

H. Kaempf Feb. 1968 34 p refs
(KFK-751) Avail: Issuing Activity

The development of a fast reactor fuel element model for investigation of effects of internal geometry on temperature distribution is described. Heat balance equations are formulated; equations describing homogeneous and inhomogeneous porosity distributions are given. The conductivity of stoichiometric uranium dioxides is shown as a function of temperature with porosity as a parameter. Effects of thermal splitting on the fuel rods are analyzed. NSA

N69-10514# National Research Council of Canada, Ottawa (Ontario).

PROPERTIES AND BEHAVIOUR OF HIGH TEMPERATURE NUCLEAR FUELS

Hj. Matzke et al 1968 112 p refs Transl. into ENGLISH from Atomkernenergie (Munich), v. 9, no. 1/2, 1964 p 2-46
(NRC-TT-1329) Avail: Issuing Activity

This survey discusses the state of research in the field of ceramic nuclear fuels. The article treats uranium dioxide, uranium carbide, and other compounds of uranium and thorium for high temperature use. Recent experiences on the behavior of ceramic fuel at high burnup are reviewed. A detailed discussion is presented on questions of atomic mobility (diffusion) in ceramic fuels. Some lines of possible future research are indicated. Author

N69-10530# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

AMPLIFICATION OF VIBRATIONS DUE TO THE REPETITION OF THERMAL SHOCKS IN A PULSED FAST REACTOR

J. Randles Brussels 1968 33 p refs
(EUR-4060.e) Avail: CFSTI

The objective of this paper is to provide a method of evaluating the amplification of fuel slug vibrations caused by the fast repetition of thermal shocks during the normal operation of a pulsed fast reactor. Such a method is required primarily for the assessment of fuel element safety. From a study of the response of a fuel slug to a discontinuous temperature rise, it is concluded that only the fundamental mode axial vibrations generated during a pulse can survive long enough to interact with the vibrations generated by the next pulse. The theory of amplification is therefore developed on the basis of the fundamental mode alone. The problem is essentially that of studying the interference between an existing wave (the cumulative product of all previous pulses) and the wave suddenly introduced at a given moment by the latest pulse. A recurrence formula relating the amplitude of vibration at any two consecutive pulses is derived. Author

N69-10559# Atomic Energy Commission, Washington, D. C.

DISPERSION-FUEL NUCLEAR REACTOR ELEMENTS

A. G. Samoilov 1968 223 p refs Transl. into ENGLISH of the book "Dispersionnye Teplovydelyayushchie Elementy Yadernykh Reatorov", Atomizdat, Moscow, 1965 p 1-223
(AEC-tr-6879; TT-68-50327; IPST-CAT-5129) Copyright. Avail: CFSTI

The design and uses of dispersion fuel elements are described. The properties required for the utilization of materials as a dispersion fuel are given. Phase diagrams of dispersion systems are included. Fabrication methods described for the production of cores for fuel elements include melting, casting, and powder metallurgy. The common methods of canning dispersion-fuel elements are described. Mechanical and physical properties given of compositions of dispersion type fuels include those fabricated by melting, casting, and powder metallurgy methods. Determination of stability, evaluation of burnup limits, changes in properties of structural materials, and other results of dispersion fuels and fuel elements during irradiation are discussed. NSA

N69-10564# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).

STUDIES ON THE APPLICATION OF TITANIUM COMPOUNDS IN NUCLEAR TECHNOLOGY [BEITRAEGE ZUR KERNTECHNISCHEN ANWENDUNG VON TITANVERBINDUNGEN]

E. Blossfeld, H. W. Levi, and E. Schiewer Jul. 1968 37 p refs In GERMAN; ENGLISH summary
(HMI-B-69) Avail: Issuing Activity

The production of $SrTiO_3$ from aqueous solutions and the co-precipitation of radioactive ions by TiO_2-aq were studied. TiO_2-aq was obtained by the hydrolysis of $TiCl_4$, titanic acid ester, or $K_2TiO(C_2O_4)_2$. A method for the decontamination of radioactive effluents is described. A $SrTiO_3$-TiO_2 mixture was obtained by ion exchange of $K_2Ti_2O_5$ with Sr ions, whereas the reaction of tetraisopropyl titanate with aqueous solutions of Sr salts at high pH values and temperatures above 65°C results in the formation of pure $SrTiO_3$. Author (NSA)

N69-10570# Oak Ridge National Lab., Tenn.

CLOSED-CIRCUIT TELEVISION VIEWING IN MAINTENANCE OF RADIOACTIVE SYSTEMS AT ORNL

R. L. Moore 1 Nov. 1967 13 p Presented at the Am. Nucl. Soc., Pittsburgh, 31 Oct.-23 Nov. 1968
(Contract W-7405-ENG-26)
(ORNL-TM-2032; CONF-681001-58) Avail: CFSTI

Considerations affecting the use of closed circuit television in radioactive systems are discussed. Equipment used for closed-circuit television viewing at the Homogeneous Reactor Test and at the Molten Salt Reactor Experiment is described. The results of a radiation test of a miniature, radiation resistant television camera are presented. Author (NSA)

N69-10576# European Atomic Energy Community, Ispra (Italy).

THE PHYSICAL THEORY OF THE DECAY OF A NEUTRON PULSE IN A FINITE MEDIUM [LA TEORIA FISCA DEL DECADIMENTO DI UN IMPULSO DI NEUTRONI IN UN MEZZO FINITO]

G. Rossi 1968 73 p refs In ITALIAN; ENGLISH summary
(EUR-4071i) Avail: CFSTI

The problem of the time evolution of a neutron pulse in a finite moderator is discussed in the framework of the Boltzmann neutron transport equation. After a presentation of the mathematical and physical background the experimental results and the recent theoretical contributions to their interpretation are reviewed. Author

N69-10577# European Atomic Energy Community, Ispra (Italy).
COMET CODE: COMPUTATION OF THE MECHANICAL AND THERMAL STRESSES IN FUEL ELEMENT CANS [CODICE COMET: CALCOLO DELLE TENSIONI MECCANICHE E TERMICHE NELLE GUAINE DI UN ELEMENTO COMBUSTIBILE]
M. Fantozzi 1968 31 p refs In ITALIAN; ENGLISH summary
(EUR-4049i) Avail: CFSTI

The code COMET is a method for calculating mechanical and thermal stresses in a cross section of fuel element claddings in a vertical pressure tube reactor, taking into account circumferential and radial temperature distributions. Axial charges are evaluated by different schemes, according to the fuel element structure and the coolant circulation direction. Author

N69-10580# Avco-Everett Research Lab., Everett, Mass.
[THERMONUCLEAR RESEARCH] Quarterly Progress Report, 26 Mar.–25 Jun. 1968
Jul. 1968 12 p refs
(Contract AT(30-1)-3863)
(NYO-3863-8) Avail: CFSTI

Research is reported on experiments in Mark 1 and 2 toroidal high energy injection devices; electron confinement in toroidal apparatus; and research on thermonuclear reactions. NSA

N69-10610# General Electric Co., Pleasanton, Calif. Vallecitos Nuclear Center.
THERMODYNAMIC DATA PROGRAM INVOLVING PLUTONIA AND URANIA AT HIGH TEMPERATURES Quarterly Report
E. A. Aitken and S. K. Evans May 1968 7 p refs
(Contract AT(04-3)-189)
(GEAP-5634; QR-3) Avail: CFSTI

Melting point data for PuO_{2-x} and $U_{0.6}Pu_{0.4}O_{2-x}$ solid solutions in the hypoetoichiometric region were obtained by the thermal arrest method. The data show a maximum at an oxygen-to-plutonium ratio between 1.70 and 1.80 for both compositions. The liquidus and solidus temperatures are nearly coincident for the PuO_{2-x} case and differ by about 35° for the mixed oxide composition. The melting point of PuO_{2-x} falls steeply at an oxygen-to-plutonium ratio below 1.73. The solidus temperature of $PuO_{1.61}$ was found to be 2300°C. The results on the melting behavior of PuO_{2-x} are compared with similar data for UO_{2-x}. Author (NSA)

N69-10633# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.
XENON PEAK LOWERING WITH A SINGLE POWER PULSE AT THE VVR-S REACTOR
Teodor Rosescu 1968 6 p refs
(IFA-FR-64) Avail: Issuing Activity

The optimal conditions of shutdown and operation of the VVR-S reactor for lowering the xenon poisoning peak are examined. Calculations were performed assuming the impossibility of a power pulse greater than nominal power and a total pulse duration time lower than 0.5 hours. The results show a single nominal pulse will lead to a slight lowering of the xenon peak and of the time when the equilibrium xenon value is reached. NSA

N69-10634# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.
THERMAL NEUTRON SPECTRA BY THE POLYNOMIAL METHOD
I. Christian 1968 10 p refs
(IFA-FR-61) Avail: Issuing Activity

The thermal neutron spectrum in the graphite thermal column of the WWR-S reactor was measured by the activation method. An orthogonal polynomial expansion was used to provide an analytical expression of the spectrum on the basis of the activation data. NSA

N69-10636# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.
NEUTRON TEMPERATURE IN THE GRAPHITE AND INTERNAL THERMAL COLUMNS OF THE VVR-S REACTOR
I. Girlea, H. Stefan, G. Fodor, and I. Cristian [1968] 12 p refs
(IFA-FR-62) Avail: Issuing Activity

The effective temperature of thermal neutron spectra in the graphite and internal thermal columns of the WWR-S reactor was measured by the activation technique using Westcott's formalism. The foil preparation, experimental procedure, and results are presented. NSA

N69-10644# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
MEASUREMENT IN PULSED BeO ASSEMBLIES WITH DECAY CONSTANTS IN THE REGION OF CORNGOLD'S LIMIT
M. T. Rainbow and A. I. M. Ritchie May 1968 30 p refs
(AAEC/TM-456) Avail: CFSTI

Decay curves have been measured in BeO assemblies with bucklings in the range 1.93×10^{-2} cm^{-2} to 5.34×10^{-2} cm^{-2} at times from immediately after the initial pulse to at least 4.5 msec after the pulse. The decay curves for assemblies with $B^2 < 2.91 \times 10^{-2}$ cm^{-2} can be described by an exponential, from a minimum of 1.5 msec after the pulse to greater than 3.0 msec after the pulse. For bucklings greater than $B^2 = 3.3 \times 10^{-2}$ cm^{-2}, the decay curves can not be described by an exponential in this time region, and the departure from exponential increases with increasing buckling. The results indicate a transition region at $B^2 \approx 3.0 \times 10^{-2}$ cm^{-2}, ($\lambda \approx 3.65 \times 10^3$ sec^{-1}) which is consistent with the expression proposed by Kothari for the upper limit on discrete decay constants and well above Corngold's limit of $\lambda^* = (v \Sigma_{inel})_{min} \approx 2.5 \times 10^3$ sec^{-1}. The transition point does not have any marked shape dependence. There is some shape dependence in the behavior of decay curves for assemblies with $B^2 \geq 3.3 \times 10^{-2}$ cm^{-2} but little dependence on pulse length, or counter shape and position. Author (NSA)

N69-10673# Eidgenoessiches Institut fuer Reaktorforschung, Wurenlingen (Switzerland).
DYNAMIC NONLINEAR BEHAVIOR OF A REACTOR [COMPORTEMENT DYNAMIQUE NON-LINEAIRE DU REACTEUR]
G. Sartos Feb. 1968 98 p refs In FRENCH
(EIR-119) Avail: CFSTI

Equations describing the nonlinear reactor dynamics are given; methods for treatment are discussed. Use of Lie series for solution to the system of differential equations is discussed; the derivation of recursion formulas is given. Methods for determination of reactor stability are discussed; fundamental theorems on stability are defined. The domain of reactor stability is determined. Dynamic characteristics of the EBWR and DIORIT are analyzed as examples; results of calculations are tabulated. NSA

N69-10674# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
NUMERICAL INVESTIGATIONS INTO METHODS OF CRITICALITY AND BREEDING RATES CALCULATION FOR REACTORS WITH CYLINDER GEOMETRY AND PARTIALLY INSERTED CONTROL RODS
W. Schwetje Mar. 1968 33 p refs Transl. into ENGLISH from German
(KFK-741; EURFNR-507; EUR-3723.d) Avail: CFSTI

In the calculation of characteristic values and integral rates for cylindrical reactors with wholly or partially inserted guide rods by means of zero, one and two-dimensional diffusion codes the method of N. Spinks offers advantages compared with previous methods both as regards precision and the calculation time. The application of this method is simple. The precondition for good results is a reactor configuration with at least six control or shutdown rods at the same distance from the core center. The most recent designs for fast breeders always provide, with steam and with Na cooling, six or more rods at the same interval from the core center. Thus, in the calculation of these reactors Spinks' method can be applied. Investigations concerning the dependence of the breeding rates on the depth of insertion of the guide rods and on the excess reactivity show that movements of the guide rods during reactor operation have only a small influence on the breeding rates, but that changes in the excess reactivity because of change in the enrichment have a considerably stronger influence on the breeding rate. Therefore, realistic breeding rates are obtained only when these are calculated for the proper excess reactivities. Author (NSA)

N69-10677# Institute of Nuclear Research, Warsaw (Poland).
STATISTICAL ANALYSIS OF THE METHOD OF PAIR SELECTION IN CONTENT ADDRESSABLE SYSTEMS
Zbigniew Hoffman 1966 66 p refs
(INR-900) Avail: CFSTI

In multiparameter experiments, content addressable systems offer a much better utilization of memory space than a conventional multiparameter analyzer. Also, in many cases the number of channels in a content addressable system is not sufficient. Input data must be selected to collect a sample of descriptors. The collection of the sample of useful information based on the principle of pair-selection is analysed. The theory of this method for discrete and continuous distribution of input information is given. Several examples with simplified distribution of descriptors are solved. The theory of sliding-pair selection and its modification is introduced and analyzed. Stastical analysis of the filling time of a store sample is given and the comparison of the filling time of a store sample for pair selection and first come, first served selection is made. Several practical applications of pair selection are proposed and discussed. Author(NSA)

N69-10689# Los Alamos Scientific Lab., N. Mex.
TESTING HEPA FILTERS FOR USE IN A HIGH NOISE LEVEL ENVIRONMENT
James D. DeField [1968] 14 p refs Presented at the Symp. on Operating and Develop. Experience in the Treatment of Airborne Radioact. Wastes, New York
(Contract W-7405-eng-36)
(LA-DC-9484; CONF-680811-5) Avail: CFSTI

During the pulsed cooling phase of nuclear reactor rocket engine tests, as part of the Rover Program at Los Alamos Scientific Laboratory, the possibility of atmospheric release of radioactive particulates exists. To control this potential release, a special air cleaning system employing High Efficiency Particulate Aerosol (HEPA) filters was designed, constructed, and tested. A primary concern was the structural integrity of these filters under the intense noise levels that exist during reactor tests. Commercially available HEPA filters were subjected to noise levels simulating the acoustic environment that exists near a reactor during testing. These acoustic exposures included both reverberant and progressive fields of varying time intervals and reached maximum sound pressure levels of 148 db. Filter efficiency tests using air-generated dioctyl phthalate (DOP) were performed before and after acoustic exposures and are reported. Details of the acoustic and DOP test methods are also discussed. (NSA)

N69-10690# Los Alamos Scientific Lab., N. Mex.
EFFICIENCY TESTING THE AIR CLEANING SYSTEM FOR A HIGH TEMPERATURE REACTOR
James D. DeField and Harry J. Ettinger [1968] 20 p Presented at the Symp. on Operating and Develop. Experience in the Treatment of Airborne Radioact. Wastes, N. Y.
(Contract W-7405-ENG-36)
(LA-DC-9483; CONF-680811-2; SM-110/32) Avail: CFSTI

The Los Alamos Ultra High Temperature Reactor Experiment (UHTREX) utilizes a helium cooled, graphite moderated reactor, employing refractory fuel elements. Under accident conditions, the effluent that may be released from this reactor requires an air cleaning system capable of reducing radioactive gas and particulate contaminants to safe levels. Dioctyl phthalate and iodine-131 were used as test aerosols for the HEPA and activated carbon filters, respectively. Methods of aerosol generation and test procedures are detailed for the preinstallation tests of the carbon and in-place testing of the carbon and HEPA filters. The importance of visual inspection of the HEPA filters prior to installation and supervision of filter installation is discussed. In-place tests indicated desirable design changes which would (1) simplify in-place testing procedures, (2) expedite installation and future changing of the filters, and (3) assure operation of a more efficient system. Author(NSA)

N69-10725# Argonne National Lab., Ill.
ARGONE CODE CENTER: BENCHMARK PROBLEM BOOK. NUMERICAL DETERMINATION OF THE SPACE, TIME, ANGLE, OR ENERGY DISTRIBUTION OF PARTICLES IN AN ASSEMBLY
Feb. 1968 73 p refs
(ANL-7416) Avail: CFSTI

The Benchmark Problem Book is intended to serve as a source-book of solutions to mathematically well-defined problems for which either analytical or very accurate approximate solutions are known. This initial collection contains benchmark problems relating to numerical determination of the space, time, angle, or energy distributions of particles in an assembly. NSA

N69-10734*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CALCULATION OF FUEL LOSS FROM VENTED NUCLEAR FUEL ELEMENTS FOR SPACE POWER REACTORS
Richard E. Gluyas Washington Nov. 1968 40 p refs
(NASA-TN-D-4913) Avail: CFSTI CSCL 18L

The rate of loss of uranium dioxide (UO_2) or of uranium mononitride (UN) from cylindrical nuclear fuel elements which are vented to prevent buildup of high fission gas pressures has been calculated for various conditions. For 10,000 *hr* operation at a cladding temperature of 1400°C and venting to a vacuum, the maximum fuel temperature allowable for UO_2 is about 2000°C and for UN about 1800°C. These temperatures may be increased to about 2500° and 2600°C, respectively, by venting to an argon atmosphere containing enough oxygen or nitrogen to prevent decomposition of the fuels. Author

N69-10737# Atomic Energy Commission, Washington, D. C. Div. of the Technical Information.
NUCLEAR REACTORS, BUILT, BEING BUILT OR PLANNED IN THE UNITED STATES AS OF JUNE 30, 1968
[1968] 34 p
(TID-8200(18th Rev.)) Avail: CFSTI

A compilation is presented of unclassified information about facilities built, being built, or planned in the United States for domestic use or export as of June 30, 1968, which are capable of sustaining a nuclear chain reaction. Information is presented in five parts, each of which is categorized by primary function or purpose. Author (NSA)

N69-10743# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PCTR MEASUREMENT OF K INFINITY FOR URANIUM-BISMUTH SUPERCELL
1 Feb. 1968 48 p refs
(Contract AT(45-1)-1830)
(BNWL-692) Avail: CFSTI

A measurement is made of the neutronic parameters for a low absorption target in a supercell consisting of a three-to-two fuel-to-target ratio with separate tubes of uranium fuel and bismuth metal target. Each tube is water cooled and surrounded by a graphite moderator on an 8.0" lattice pitch. The bismuth target elements are relatively larger (3.750" O.D.) than the uranium fuel elements (1.508" O.D.) in order to irradiate as much of the target material as possible because of the significantly low bismuth cross section. Four-inch square hole bars are removed from each target cell to contain a round aluminum process tube with the target elements. The graphite hole bars for the fuel cells contained 2.0" O.D. holes and zirconium process tubes. The experiment is conducted in the Physical Constants Testing Reactor (PCTR) for a zero exposure case at room temperature. The reactivity effect of coolant loss is included in these measurements. Author (NSA)

N69-10758# Argonne National Lab., Ill.
POSTFABRICATION EVALUATION OF INTEGRITY AND SERVICEABILITY OF CANNED GRAPHITE FOR THE EBR-2 NEUTRON SHIELD
A. H. Heineman Mar. 1968 39 p
(ANL-7424) Avail: CFSTI

The neutron shield for EBR-II consists of plain and/or boronated graphites in Type 304 stainless steel cans positioned inside and around the reactor vessel and within the vessel cover. A series of pre- and post-fabrication tests of the reliability and integrity of the neutron shield in EBR-II operating conditions, exclusive of radiation, are described. The tests include: prefabrication tests of prototype can assemblies and graphite to develop commercial fabrication criteria, post-fabrication tests of spare as-built cans to ensure vendor conformity with specifications, and tests with deliberately defected cans to assess the consequences of deviations from specifications or can failure on reactor safety and operation. The tests indicate that can performance and fabrication procedures are satisfactory. NSA

N69-10760# Atomics International, Canoga Park, Calif.
HEAVY WATER ORGANIC COOLED REACTOR. COMPATIBILITY OF HYPERSTOICHIOMETRIC UC AND SINTERED ALUMINUM POWDER (SAP)
A. B. Bremer 31 May 1968 64 p refs
(Contract AT(38-1)-430)
(AI-CE-77) Avail: CFSTI

The status of hyperstoichiometric UC fuel–SAP cladding compatibility studies, applicable to HWOCR conditions, is presented. Diffusion couple interfaces were evaluated, both metallurgically and statistically. Regression equations established correlations between test conditions and the dependent variables of total reaction thickness and uniform reaction thickness. An incubation period, which occurs early in the compatibility reaction, is described. A U–Al–Si phase and impurity elements, including Si and Fe, were detected in the reaction zone by electron beam microprobe analysis. UAl_3 and C (graphite) were detected by X-ray diffraction. A comparison of in-pile and out-of-pile compatibility data suggests an absence of irradiation effects. The influence of diffusion couple interfacial pressure on the compatibility reaction is discussed. Six steps are suggested to define the compatibility reaction process. Author (NSA)

N69-10763# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
LATTICE MEASUREMENTS WITH 19-ELEMENT RODS OF THORIUM DIOXIDE URANIUM-235 DIOXIDE IN HEAVY WATER MODERATOR. PART 2: RELATIVE FISSION RATES, FAST FISSION RATIO, CONVERSION RATIO, AND COMPARISON WITH CALCULATIONS
Albert Okazaki Jun. 1968 41 p
(AECL-2779-PT-2) Avail: CFSTI

Lattice parameter measurements of heavy water moderated lattices of 19-element clusters of ThO_2 containing 1.5 w/o UO_2 (93 a/o ^{235}U) are presented. Relative ^{233}U, ^{235}U and ^{239}Pu fission rates, fast fission ratio, and conversion ratio measurements are described. D_2O, air, H_2O and organic HB40 coolants were studied at 22 and 28 cm triangular lattice pitches. Additional analyses of the critical substitution measurements have been made and revised bucklings are given. Calculations made with the LATREP and HAMMER codes are compared with measured lattice parameters. Both codes underestimate the buckling by up to 1 m^{-2} with the largest discrepancy at the tightest lattice pitch. The calculations overestimate the neutron disadvantage factor and conversion ratio. Author (NSA)

N69-10768# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
AMERICIUM, CURIUM, AND PLUTONIUM YIELDS IN SRP HIGH FLUX IRRADIATION
C. J. Banick Jul. 1968 7 p refs
(Contract AT(07-1)-1)
(DP-1157) Avail: CFSTI

Analyses of sections of four $^{242}PuO_2$ targets irradiated at high flux in SRP reactors indicated that the ^{244}Cm and ^{245}Cm yields are near equilibrium between exposures of 5×10^{22} n/cm^2 and 9×10^{22} n/cm^2. High fission losses reduce yields of higher mass isotopes at these exposures. The yields of ^{246}Cm, ^{247}Cm, and ^{248}Cm are still increasing at 9×10^{22} n/cm^2. Fission products correspond to the consumption of $\approx$ 29% of the initial plutonium after an exposure of 9×10^{22} n/cm^2. Author (NSA)

N69-10773# Battelle-Northwest, Richland, Wash. Pacific-Northwest Lab.
AIRBORNE RELEASE OF PARTICLES IN OVERHEATING INCIDENTS INVOLVING PLUTONIUM METAL AND COMPOUNDS
L. C. Schwendiman, J. Mishima, and C. A. Radasch 31 Jul. 1968 19 p refs Presented at the Symp. on Operating and Develop. Experience in the Treat. of Airborne Radioact. Wastes, N. Y.
(Contract AT(45-1)-1830)
(BNWL-SA-1735; CONF-680811-1) Avail: CFSTI

Observations are given from a study in which the airborne release of plutonium and its compounds was measured during an exposure of the material of interest containing plutonium to temperatures which may result from fires. Aerosol released from small cylinders of metallic plutonium ignited in air at temperatures from 410°C to 650°C ranged from 3×10^{-6} wt % to 5×10^{-5} wt %. Particles smaller than 15 μ in diameter represented as much as 0.03% of the total released. Large plutonium pieces weighing from 456 to 1770 grams were ignited and allowed to oxidize completely in air with a velocity of around 500 cm/sec. Release rates of from 0.0045 to 0.032 wt % per hour were found. The median mass diameter of airborne material was 4 μ. Quenching the oxidation with magnesium oxide sand reduced the release to 2.9×10^{-4} wt % per hour. Many experiments were carried out in which plutonium compounds as powders were heated at temperatures ranging from 700 to 1000°C, with several air flows. Author (NSA)

N69-10776# Sandia Corp., Albuquerque, N. Mex.
DESIGN OF SPACE NUCLEAR POWER SUPPLIES FOR INTACT REENTRY

R. D. Klett May 1968 34 p refs
(SC-RR-68-351) Avail: CFSTI

It was found that it is safer to contain some fuel forms throughout reentry rather than attempt to disperse the fuel at high altitudes. The environments that intact nuclear power supplies are exposed to are discussed. The requirements each environment places on the design are covered, and basic design concepts are suggested. Parametric time-saving methods are presented for analysis of some early phases of power supply thermal design. Author (NSA)

N69-10794# Argonne National Lab., Ill. Reactor Engineering Div.

TRANSIENT THERMAL STRESSES ASSOCIATED WITH SUDDEN INITIATION OF INTERNAL HEAT GENERATION IN A SEGMENT OF A CIRCULAR CYLINDER

Richard A. Valentin and Daniel F. Schoeberle (Illinois Univ., Chicago) Mar. 1968 28 p refs
(Contract W-31-109-ENG-38)
(ANL-7420) Avail: CFSTI

An exact solution is given for the quasi-static thermal-stress field associated with the transient temperatures arising when an infinite, homogeneous, isotropic, right circular cylinder, cooled at its surface by a temperature-independent boundary conductance, suddenly begins, and thereafter maintains, uniform internal heat generation within a finite axial region. The problem is of interest in certain nuclear-reactor analyses related to the behavior of fuel elements during power transients. The solution form is well suited to numerical evaluation, and extensive numerical results are given. Author (NSA)

N69-10796# Argonne National Lab., Ill. Chemical Engineering Div.

REVIEW OF LOW-MASS ATOM PRODUCTION IN FAST REACTORS

Norman D. Dudey Apr. 1968 37 p refs
(Contract W-31-109-ENG-38)
(ANL-7434) Avail: CFSTI

A literature review of low-mass charged-particle yields in fission is presented. A semiempirical method for calculating the yields of H and He isotopes from fast-neutron fission of U and Pu is presented. Total and specific production rates of ^{1}H, ^{2}H, ^{3}H, ^{3}He, ^{4}He, and ^{6}He are estimated for the reactor fuels ^{233}U, ^{235}U, and ^{239}Pu. The T production in reactor fuels is estimated at 327 Ci per metric ton of ^{235}U fuel and 440 Ci per metric ton of a 50% mixed ^{235}U–^{239}Pu thermal reactor fuel having a burnup rating of 20,000 MW(t)-D. T production in fast reactors is estimated to be 10% lower for ^{235}U fuel and 10% higher for ^{239}Pu fuel than for thermal reactors. An examination of all sources of H and He in EBR-II is presented. Neutron reactions of stainless steel are shown to produce 90% of the H_2 and 10% of all He-produced in EBR-II. T production in fast reactors is shown to result almost entirely from fission. A Pu-fueled reactor is estimated to produce nearly twice as much T as a U-fuel thermal reactor. Author (NSA)

N69-10797# Union Carbide Nuclear Co., Oak Ridge, Tenn. Gaseous Diffusion Plant.

ENGINEERING DEVELOPMENT OF AN ABSORPTION PROCESS FOR THE CONCENTRATION AND COLLECTION OF KRYPTON AND XENON Second Summary Progress Report, Jul.–Dec. 1967

J. R. Merriman and J. H. Pashley 19 Aug. 1968 31 p refs
(Contract W-7405-eng-26)
(K-1745) Avail: CFSTI

One of the most direct methods for stripping krypton and xenon from contaminated gas streams is selective absorption in a fluorocarbon solvent, such as refrigerant-12. A development program is under way to establish engineering scale-up data required for design of plants using the absorption technique for processing gases containing radioactive krypton and xenon isotopes. The scope of the work includes pilot plant testing, conceptual design studies for various plant-scale applications of the processes, and optimization studies. During this report period, construction and procurement of the pilot plant equipment items were essentially completed, and installation was begun. The conceptual design effort was temporarily reduced pending collection of pilot plant data to guide the selection of promising plant operating conditions. The basic material balance model used in the optimization work has been constructed, programmed, and tested; and equipment sizing and costing routines are currently being developed for incorporation into the material balance code. Author (NSA)

N69-10806# Japan Atomic Energy Research Inst., Tokyo.

DEVELOPMENT OF IN-CORE VOID METER

Masahiro Satomi et al Sep. 1968 16 p refs Transl. into ENGLISH from Trans. Soc. Instr. Control Engrs. (Tokyo), v. 3, no. 3, Sep. 1967 p 229–235
(NSJ-TR-135) Avail: CFSTI

In order to measure steam void fractions in operating boiling water reactors, two types of void-meter were developed. One consists of a solenoid, a high frequency oscillator, a bridge, and other suitable electric circuits and detects impedance change induced by voids passing through the solenoid. The other uses a thin needlelike electrode to detect heat and detects the changes of capacitance and resistance induced when the electrode collides with and penetrates a bubble. Since the changes of impedances induced by void were very small, special electric circuits were also devised to detect the small signals. The solenoid type void-meter responds promptly with high sensitivity, and is suitable for measuring mean void fractions in the solenoid under transient conditions, while the digital type void-meter is small in size and is applicable to measuring time-averaged local void fractions. These performances were examined through out-pile experiments. The detecting heads of the void-meters were designed and manufactured with special considerations so as to be used under the conditions of high pressure and high irradiation. Author

N69-10838# Argonne National Lab., Ill. Reactor Physics Div.

THE ARGONNE REACTOR COMPUTATION (ARC) SYSTEM

B. J. Toppel, ed. Nov. 1967 349 p refs
(Contract W-31-109-ENG-38)
(ANL-7332) Avail: CFSTI

The purpose and basic concepts of the ARC system to facilitate reactor physics calculations that involve many independent computations are presented. The system is being implemented on an IBM 360 Model 50-75 computer complex, and has two major advantages over conventional computer codes. These are: (1) The ability to automate the linkage of computational modules without human data handling. (2) The ability to store and later retrieve data generated by an ARC run to facilitate the rerunning of previous problems with data changes or to extend previous problems into further computational areas. The system consists of: (1) The Datapool for collection of data and computational algorithms that can be used by ARC. (2) Computational Modules which are conventional program subroutines. (3) Standard Paths which are control programs similar to the driver portions of large conventional codes. (4) Operating system for collection of codes which form the interface between ARC and the computer hardware. The system structure and modules are described and a data module glossary is presented. NSA

N69-10844# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung.

METHOD FOR THE EXPERIMENTAL INVESTIGATION OF THE NATURAL FREQUENCY OF THE NORMAL AND

EXPANDED FUNCTION AS WELL AS THE ATTENUATION OF THE TRANSVERSE FUEL ROD VIBRATION [METHODE FUER DIE EXPERIMENTELLE UNTERSUCHUNG DER EIGENFREQUENZEN, DER NORMAL- UND DER DEHNUNGSFUNKTIONEN SOWIE DER DAEMPFUNG DER QUERSCHWINGENDEN BRENNSTAEBE]

J. Kadlec and V. Pfrommer Mar. 1968 25 p refs In GERMAN; ENGLISH summary Sponsored by EURATOM
(KFK-731; EUR-3718D) Avail: CFSTI

Methods for the experimental investigation of the eigenfrequencies, and the associated eigenfunctions, of fuel rods are described. Equations for a free swinging fuel rod are developed; from these, the equations of damped motion are derived. Experimental apparatus used for the measurements is described; the methods for measuring the resonance curve, phase, and amplitude are discussed. NSA

N69-10849# Atomics International, Canoga Park, Calif.

HEAVY WATER ORGANIC COOLED REACTOR: FUEL IRRADIATION EXPERIMENT EXP-NRU-305, ALTERNATE 1

E. D. Falk, R. E. Forrester, W. B. Wolfe, and R. J. Sullivan 15 Jun. 1968 73 p refs Prepared in cooperation with Combust. Eng., Inc., Windsor, Conn.
(Contract AT(38-1)-430)
(AI-CE-75) Avail: CFSTI

The 305-U AI experiment was the second in the 305-U series of fueled irradiations in support of the HWOCR program. The irradiation was conducted in the organic cooled U-3 loop in the AECL-owned NRU reactor at Chalk River, Ontario. The fuel string consisted of three SAP-clad UC bundles and two Zircaloy-4-clad UO_2 bundles. The fuel string operated very satisfactorily for 17 months at design conditions of 20.8 kw/ft peak power rating, 326,000 Btu/hr-ft^2 peak cladding heat flux, and reached a record burnup on the SAP-UC fuel of 16,700 Mwd/MTU (peak) and a peak burnup of 14,000 Mwd/MTU on the Zr-UO_2 fuel. This experiment showed that coolant impurity levels can be much higher than levels previously considered acceptable in organic cooled systems. Although the normal indices of coolant purity were allowed to rise to levels heretofore thought unacceptable, the fuel continued to operate satisfactorily without fouling. Author (NSA)

N69-10851# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Inst.

UHV-SYSTEM FOR A REACTOR BEAM TUBE

E. Baltacis, R. Dobrozemsky, and W. Kubischta 1967 15 p refs Presented at the 4th Gen. Meeting on Intern. Organ. for Vacuum Sci. and Technol., Manchester, England Submitted for publication
(Contract AF 61(052)-857)
(SGAE-PH-67/1968; CONF-680401-5) Avail: CFSTI

For an experiment on free neutron decay the energy spectrum of the decay protons which have energies of a few hundred eV are measured. The decay protons originate near the reactor core in a tangential beam tube. The spectrometer and detector are placed 4 meters from the reactor core outside the reactor shield. To reduce interactions with the gas atoms, which results in an energy-dependent transmission of the protons, a bakeable all-metal system is necessary. The baking temperature is limited by the presence of magnetic shielding material and by reactor safety considerations to about 100°C. In the central parts of the beam tube the outgassing rates are increased by the presence of γ and neutron radiation (dose rate about 10^8 rad/h). Since the conductance between this source of gas and the pump is only a few litres/sec it is necessary to investigate the reactor outgassing effect. The outgassing properties of Al under reactor irradiation after moderate bakeout procedures are discussed. A heavy increase of outgassing rates is recorded and found to be caused mainly by γ radiation. Author (NSA)

N69-10862# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

SPERT PROJECT Quarterly Technical Report, Apr.-Jun. 1967

T. G. Taxelius, ed. Jun. 1968 46 p refs
(Contract AT(10-1)-205)
(IDO-17270) Avail: CFSTI

The objective of the Spert III Oxide Core Kinetics Test program is to study reactor kinetic behavior under conditions typical of pressurized-water reactors. The core used is a slightly enriched, UO_2-fueled core, designated the E-core. Experimental data on the transient behavior of the reactor for step reactivity insertions up to 1.25$ with low initial reactor power and various initial system conditions are presented. Calculations of the kinetic behavior of the E-core are performed using the point reactor kinetics equations in the IREKIN and PARET computer codes. Analysis of fuel rod deformation is presented. Transient testing to establish the operational capability of the Spert IV Capsule Driver Core (CDC) is described. A hydraulically driven transient rod drive for the Power Burst Facility is described for providing the controlled reactivity insertion rates required for shaping the power burst. Computer models of the hydraulic drive, combined with a simulation of PBF reactor kinetics, are developed to predict the performance of the reactor during a burst-shaping operation. Performance tests on a prototype of the hydraulic drive verify the accuracy of the computer models. Author (NSA)

N69-10870# European Atomic Energy Community, Brussels (Belgium). Directorate General for General Research and Technology.

IN-PILE THERMAL EXPANSION OF URANIUM DIOXIDE TENTATIVE SYNTHESIS [DILATATION THERMIQUE DU BIOXYDE D'URANIUM EN PILE ESSAI DE SYNTHESE]

H. Marchandise 1968 63 p refs In FRENCH; ENGLISH summary
(EUR-4033f) Avail: CFSTI

This report is a tentative synthesis of the published data on the in-pile thermal expansion behaviour of uranium dioxide in sintered pellet shapes. Author

N69-10871# Kernforschungszentrum, Karlsruhe (West Germany). Inst. Fuer Heisse Chemie.

ON THE DISSOLUTION OF BREEDER FUELS CONTAINING PuO_2 IN NITRIC ACID FOR AQUEOUS REPROCESSING BY THE PUREX METHOD

W. Baehr and Th. Dippel Jul. 1967 20 p refs Transl. into ENGLISH from German
(KFK-673; EURFNR-471; EUR-3704.d) Avail: CFSTI

The dissolution behavior of unirradiated PuO_2 powder and UO_2–15% PuO_2 sintered pellets was investigated in relation to varying sintering data. Dissolution rates and residues were determined after 8 hr in 14M HNO_3. It was found that UO_2–15% PuO_2 pellets at 1500°C after 32 hr, at 1600°C after 16 hr, and at 1700°C after 8 hr exhibit extensive mixed phases and are therefore completely soluble. With these results the question of the reprocessing of breeder fuels is answered positively. If the fuel is subjected to sintering conditions such that extensive mixed crystals are formed between PuO_2 and UO_2, it is possible to achieve dissolution without special difficulty. The solutions resulting from this dissolution can be diluted until they are doubled in volume and then used as feed solutions for the Purex Process. Author (NSA)

N69-10872# Japan Atomic Energy Research Inst., Tokyo.

FURNACE: THE TWO-DIMENSIONAL BURN-UP CODE FOR FAST REACTORS

Tomoo Suzuki 1968 20 p refs In JAPANESE; ENGLISH summary
(JAERI-1164) Avail: CFSTI

The code FURNACE has been developed for detailed study of burn up characteristics of fast reactors. The code solves

two-dimensional diffusion equations on the CDC-3600 computer. The equations are solved by difference method. In order to meet requirements from thermal hydraulic calculation, detailed power distribution at each time step are needed. So neutron fluxes are obtained by an iterative method. The EQUIPOISE method is used in the code and coefficients of each mesh point are stored in the core memory (98K) so that a duplicate recalculation for the coefficients is not needed. The code can be used for criticality calculation without burn up. In burn up calculation, the treatments used in the code TORCH (JAERI-memo 2312) are engaged: the resonance self-shielding factors are recalculated whenever changes of atomic concentrations occur in due course of burn up or criticality adjustments. The one dimensional 26 group diffusion equations are solved for obtaining the neutron spectra to be used for deriving a few group constants in each region. At this stage criticality is maintained by adjustments of concentration of fuel, fertile or poison, if necessary. At present the Russian set is used for calculations and the auxiliary code LTFURN has also been prepared for making library tape based on the Russian set. Author

N69-10875# Oak Ridge National Lab., Tenn.
REMOVAL OF XE^{135} FROM CIRCULATING FUEL SALT OF THE MSBR BY MASS TRANSFER TO HELIUM BUBBLES
F. N. Peebles 23 Jul. 1968 33 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2245) Avail: CFSTI

Removal of dissolved ^{135}Xe by mass transfer to He bubbles offers an attractive means of controlling the ^{135}Xe poison level in molten salt breeder reactors (MSBR). Extensive literature references point to reliable equations for prediction of mass transfer rates to single bubbles rising in stationary liquids under the two extreme cases of rigid bubble interface and of a perfectly mobile bubble interface. An elementary analysis of the rates of mass transfer to bubble carried along by turbulent liquid in a pipe is presented. The results indicate that the bubble mass transfer coefficient for 0.02 in. diameter bubbles will be approximately 13 ft/hr for mobile-interface bubbles, and approximately 2 ft/hr for rigid-interface bubbles. An experiment is suggested to provide specific data on the mass transfer rates to bubbles carried along by turbulent liquid in a pipe for hydrodynamic conditions which simulate the MSBR. Author (NSA)

N69-10890# Oak Ridge National Lab., Tenn.
MSRE DESIGN AND OPERATIONS REPORT. PART 11-A: TEST PROGRAM FOR U-233 OPERATION
J. R. Engel Sep. 1968 18 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2304) Avail: CFSTI

The initial critical experiment with the MSRE containing a complete ^{233}U core is described. The calculational techniques used to predict the critical U concentration in the MSRE are analyzed. The loading sequence and power operation of the reactor are described. NSA

N69-10893# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Festkorper- und Neutronenphysik.
IDENTIFICATION AND NUCLEAR SPECTROSCOPY OF SEVERAL SHORT LIVED FISSION PRODUCTS WITH AN ON-LINE MASS-SEPARATOR [IDENTIFIZIERUNG UND KERNSPEKTROSKOPISCHE UNTERSUCHUNG EINIGER KURZLEBIGER SPALTPRODUKTE MIT EINEM ON-LINE MASSENSEPARATOR]
J. Eidens Jul. 1968 58 p refs In GERMAN
(NP-17528) Avail: CFSTI

At the focus of the helium-filled mass separator for fission products at the Juelich-2 research reactor, an apparatus for nuclear spectroscopy on short-lived fission products was constructed. A mass calibration of the separator was carried out by the use of the γ radiation of known long-lived fission products. In the unknown short-lived fission products, the half-life of the decay was determined on the basis of some very intense γ lines. The lines found were assigned to 8 nuclides, for which the following half-lives and Q-values of the β decay were measured: ^{94}Se, 3.5 $\pm$ 0.1 min and 1.8 $\pm$ 0.1 MeV; ^{91}Kr, 7.9 $\pm$ 0.5 sec and 5.7 $\pm$ 0.4 MeV; ^{97}Y, 1.11 $\pm$ 0.03 sec and 5.7 $\pm$ 0.2 MeV; ^{99}Nb, 14.3 $\pm$ 0.6 sec and 3.7 $\pm$ 0.2 MeV; ^{98}Zr, 2.4 $\pm$ 0.1 sec and 4.5 $\pm$ 0.2 MeV; ^{100}Nb, 6.6 $\pm$ 0.2 sec and 6.5 $\pm$ 0.3 MeV; ^{101}Nb, 7.0 $\pm$ 0.2 sec and 4.6 $\pm$ 0.2 MeV; and ^{101}Zr, 3.3 $\pm$ 0.8 sec and 6.5 $\pm$ 0.7 MeV. In three cases the decay curves obtained permit the following estimation for the half-lives of the mother nuclides: ^{97}Sr, 0.4 $\pm$ 0.3 sec; ^{99}Y, 0.8 $\pm$ 0.7 sec; and ^{100}Zr, 1.0 $\pm$ 0.9 sec. Author (NSA)

N69-10898# Union Carbide Nuclear Co., Oak Ridge, Tenn.
NUCLEAR SAFETY STUDIES FOR LOW-ENRICHMENT FLUORIDE VOLATILITY FUEL REPROCESSING PLANTS
K. E. Habiger and D. L. Breton 4 Sep. 1968 66 p refs
(Contract W-7405-eng-26)
(K-1734) Avail: CFSTI

Conceptual and hardware development studies are being made relative to the design of fluoride volatility fuel reprocessing plants for low enrichment nuclear reactor fuels. As a part of this effort, criticality calculations were made to establish reactivities of various assemblies of uranium and plutonium with other volatility process materials. These results were then used as bases for estimating the geometry or fissile mass limitations for the conceptual plant processing equipment. The DTF-II and ANISN one dimensional S_n multigroup transport codes were used in the S_4 option for the calculations. For uranium, calculations were made for cases involving homogeneous mixtures of uranium dioxide and alumina, uranium dioxide and water, uranium hexafluoride and hydrogen fluoride, and disodiumoctofluorouranate and sodium bifluoride. The maximum ^{235}U assay considered was 5%. Author (NSA)

N69-10899# Atlantic Richfield Hanford Co., Richland, Wash.
RECLAMATION OF A PARTIALLY PLUGGED GLASS FIBER VENTILATION FILTER AT THE HANFORD PUREX NUCLEAR FUELS REPROCESSING PLANT
B. E. Clark, D. F. Davis, and W. C. Schmidt 31 Jul. 1968 21 p refs Presented at the Symp. on Operating and Develop. Experience in the Treat. of Airborne Radioact. Wastes, N. Y., 26-30 Aug. 1968
(Contract AT(45-1)-2130)
(ARH-SA-9; CONF-680811-6) Avail: CFSTI

Canyon ventilation air from the Hanford Purex Nuclear Fuels Reprocessing plant is exhausted through a filter system before being released to the atmosphere. The filter installation consists of a bulk-particulate removing, glass fiber fore-filter, and a fine-particulate removing, high efficiency, glass fiber after-filter. Core samples of the fore-filter glass fiber bed showed a predominantly ammonium nitrate loading confined to the inlet side of the bed. Based on the laboratory studies the partially plugged original filter, after removal from operation, was treated for reclamation using a small flow of highly humidified air through the fore-filter. The results of the reclamation treatment were satisfactory and it was possible to return the original filter installation to service handling the entire exhaust ventilation flow. The filter was reclaimed at a cost of $15,000; the filter replacement cost $750,000. Author (NSA)

N69-10910# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
URANIUM-PLUTONIUM CARBIDE DEVELOPMENT Quarterly Progress Report, Period Ending 30 Jun. 1968

A. Biancheria and W. R. Jacoby Aug. 1968 62 p refs
(Contract AT(30-1)-3791)
(WARD-3791-21) Avail: CFSTI

Preparation of fuel for the EBR_2 irradiation test samples and development of improved characterization techniques for better identification of these samples are reported. To aid the preparation of the fuel, investigations were made on several process variables, which included binder additions, reprocessing out-of-specification fuel, and nitrogen impurity. Since the revised irradiation program specified fuels for which there is no previous fabrication experience in the laboratory, development of methods for preparing these fuels is in progress. Evaluation of etching techniques to improve identification of the structure resulted in reasonable success using a combination of cathodic-vacuum and electrolytic etching. A 110-kVA radiographic unit was installed to provide improved sodium-bond characterization. Studies were initiated to determine which steps in the fuel pin assembly process contributed most to the oxygen contamination of sodium. Nine (U–Pu)C fuel pins continued to function satisfactorily in GETR. Maximum burnup achieved to date exceeds 25,000 MWd/t. To evaluate the performance of (U–Pu)C fuel pins in a fast flux, the detailed nuclear, thermal, and mechanical design of a revised program (16 pins) was nearly completed. NSA

N69-10911# Oak Ridge National Lab., Tenn.
LOFT ASSISTANCE PROGRAM IN ENGINEERING DEVELOPMENT AND NUCLEAR SAFETY TESTS AT THE OAK RIDGE NATIONAL LABORATORY
G. W. Parker, G. B. Matheney, and R. E. Adams Aug. 1968 75 p
(Contract W-7405-eng-26)
(ORNL-4265) Avail: CFSTI

The LOFT Assistance Program at ORNL is designed to provide numerical data needed to develop and evaluate analytical models for predicting release, transport and containment behavior of fission products in the safety analysis of water reactors. The status of the LOFT Assistance Program after three years and the requirements for its reorientation in support of the LOFT Emergency Core Coolant Systems Tests are reviewed. Author (NSA)

N69-10913# Union Carbide Nuclear Co., Oak Ridge, Tenn.
SOLID ANGLE METHOD OF SPACING
C. E. Newlon 8 Aug. 1968 5 p refs Presented at the Symp. on Neutron Interaction in Arrays of Fissionable Mater., Livermore, Calif.
(Contract W-7405-eng-26)
(K-L-6214; CONF-680909-2) Avail: CFSTI

The solid angle method for assembling safe arrays of fissile material is formulated. The spacing criteria specify that an array unit should be: (a) individually safe for the system moderator and reflector, and (b) separated on the basis of an allowable solid angle or at a safe isolation distance for the separation medium. A safe interaction curve for units with specified multiplication factors is presented. NSA

N69-10947# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
VANADIUM ALLOY CLADDING DEVELOPMENT Quarterly Report, for the Period Ending 30 Jun. 1968
E. C. Bishop, R. A. Nader, and G. A. Whitlow Jul. 1968 60 p refs
(Contract AT(30-1)-3791)
(WARD-3791-20) Avail: CFSTI

Progress in the development of V alloy fuel cladding is reported. Details are given of investigations of sodium corrosion, alloy selection and fabrication, fuel element design, structural and mechanical properties, alloy-fuel compatibility, and irradiation performance. NSA

N69-10965# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
THORIUM EXTRACTION WITH THENOYLTRIFLUOROACETONE FROM NITRIC SOLUTIONS OF IRRADIATED FUELS AND ITS DIRECT SPECTROPHOTOMETRIC DETERMINATION ON ORGANIC PHASE [ESTRAZIONE DI TORIO CON TENOILTRIFLUOROACETONE DA SOLUZIONI NITRICHE DI COMBUSTIBILE IRRAGGIATO E DETERMINAZIONE SPETTROFOTOMETRICA DIRETTA SULLA FASE ORGANICA]
V. Pompei and F. Leo 1968 34 p In ITALIAN; ENGLISH summary
(RT/CHI(68)27) Avail: CFSTI

A simple method is described which allows the determination of thorium in the presence of other ions. The method is based on the thorium extraction with thenoyltrifluoroacetone and its direct spectrophotometric determination on organic phase. The method is suitable for irradiated reactor power fuels, the fission products decontamination factor being more than 10^2. Author

N69-10974# Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Lab. Fisica e Calcolo Reattori.
PHYSICAL FOLLOW-UP OF EBWR OPERATION BY NUCLEAR CODES DEVELOPED BY C.N.E.N. Part 1: ANALYSIS OF THE INITIAL CRITICAL EXPERIMENTS
S. Lopez and M. Michelini 1968 44 p refs
(RT/FI(68)22, Pt. 1) Avail: CFSTI

Summarized are results of initial critical calculations and experiments performed on plutonium fueled boiling water reactor cores. Assessed are the choice of an allowed geometrical model; cold plutonium critical loading; uniform temperature coefficients of the 36 assembly loading; uniform temperature coefficients of the full loading; and critical full core configurations with different arrangements of control systems. S.C.W.

N69-10992# Japan Atomic Energy Research Inst., Tokyo.
ON THE MICROSTRUCTURE CHANGE INDUCED BY CENTER MELTING AND THE FORMATION OF CENTRAL VOIDS IN POWDER COMPACTED UO_2 FUEL
Tadashi Kubota, Yoshinobu Seki, and Shuichiro Takahashi [1968] 16 p refs Transl. into ENGLISH from Nippon Kinzoku Gakkaishi (Japan), no. 31, 1967 p 406–412
(NSJ-TR-124) Avail: CFSTI

The microstructural changes induced by center melting and the formation of central voids in powder compacted UO_2 fuel were studied by center line heating in order to obtain information for interpreting the data of in-pile tests which were done in parallel with this experiment. Single crystalline columnar grains and equiaxed grains were grown in the molten region during the heating process and solidified by the subsequent cooling process, while columnar grains having lenticular voids were grown in the region kept in the solid state throughout the experiment. Both types of columnar grains showed different growth patterns depending upon the change in the extent of the molten zone. When the molten zone was large, large single crystalline columnar grains were grown in the central region, while small columnar grains having lenticular voids were grown in the region surrounding the large central grains. When the molten zone was small, large columnar grains having lenticular voids were grown in the central region. The central voids were grown not only by melting down but also by shrinkage of powder compact associated with sintering when the temperature of central region was high enough to induce the sintering of UO_2. Author (NSA)

N69-10997# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
A CONSIDERATION OF HIGH NICKEL CONTENT ALLOYS FOR FTR CORE STRUCTURAL MATERIALS

R. N. Johnson, E. A. Kovacevich, and R. A. Moen Aug. 1968 40 p refs
(Contract AT(45-1)-1830)
(BNWL-748) Avail: CFSTI

Physical and mechanical properties for selected materials to be used in fabricating FTR core components are presented. The materials tested include Type 304 stainless steel, Type 316 stainless steel, Incoloy 800, Inconel 600, Nickel 200, Inconel X-750, Inconel 718, Satellite 1016, and Stellite 6B. Thermal stability, irradiation effects, fabricability, weldability, and costs are considered in deriving the optimum materials. NSA

N69-11002# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant.
ON-LINE COMPUTERS AT THE SAVANNAH RIVER PLANT
K. L. Gimmy Jan. 1968 15 p
(Contract AT(07-2)-1)
(DPSPU-68-30-1) Avail: CFSTI

A description of the on-line digital computer control system for the Savannah River Production Reactor is presented. NSA

N69-11021# Minnesota Mining and Mfg. Co., St. Paul, Minn. Space and Defense Products.
CHARACTERIZATION OF SNAP-21 AND SNAP-23A THERMOELECTRIC MATERIALS
1 Aug. 1968 43 p ref
(Contracts AT(30-1)-3824; AT(30-1)-3691)
(MMM-3691-37; MMM-3824-0025) Avail: CFSTI

Values of the Seebeck coefficient, thermal conductivity, and resistivity of 5 types of material used in converters and thermoelectric generators in SNAP-23A and SNAP-21 were determined as a function of temperature over the range of room temperature to 1300°C. General descriptions are given of the apparatus and procedures used. NSA

N69-11023# Idaho Nuclear Corp., Idaho Falls.
TURBO-40: A TWO-DIMENSIONAL NUCLEAR REACTOR DEPLETION PROGRAM FOR THE IBM 7040-44 COMPUTER
G. R. Poetschat and R. J. Wagner (Phillips Petrol. Co., Idaho Falls) Aug. 1968 87 p refs
(Contract AT(10-1)-1230)
(IN-1184) Avail: CFSTI

TURBO-40 is an IBM 7040-44 computer program which obtains a numeric solution to the few-group, time-independent, two-dimensional neutron-diffusion equations with coupling to the linear, first order, ordinary differential equations which describe the build-up and depletion of isotopic number densities over a time interval. The group-averaged macroscopic cross sections for the few-group neutron diffusion equations are computed from fitted few-group microscopic cross sections and isotopic atom densities. The build-up or depletion of isotopic number densities describing the materials present is calculated from the fitted cross sections and the neutron flux. The flux is assumed to be constant over the time interval of each step and is recomputed for each succeeding step. The solution is obtained either over a rectangular surface in X-Y coordinates or over a right cylinder in R-Z coordinates. The number of lethargy groups is two, three, or four, and the total number of mesh points of solution is limited to 20,000. TURBO-40 is a conversion to the IBM 7040-44 of the TURBO program as reported in "Nuclear Reactor Depletion Programs for the Philco-2000 Computer," WAPD-TM-221. A user's guide for the TURBO-40 program is presented. Author (NSA)

N69-11025# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
IN REACTOR PERFORMANCE OF DEFECTED ZIRCALOYCLAD U_3Si FUEL ELEMENTS IN PRESSURIZED AND BOILING WATER COOLANTS
M. A. Feraday, G. M. Allison, J. F. R. Ambler, G. H. Chalder, and J. J. Lipsett May 1968 36 p
(AECL-3106; EXP-NRX-61607) Avail: CFSTI

The results of two in-reactor defect tests of Zircaloy-clad U_3Si are reported. In the first test, a previously irradiated element (5300 MWd/tonne U) was defected then exposed to first pressurized water then boiling water at 270°C. In the second test, an unirradiated element containing a central void was defected, waterlogged, then exposed to pressurized water for 50 minutes. Both tests were terminated because of high activity in the loop coolant detected by both γ and delayed neutron monitors. Post-irradiation examination showed that both elements had suffered major sheath failures which were attributed to the volume increase accompanying the formation of large quantities of corrosion product formed by the reaction of water with the hot central part of the fuel. It was concluded that the corrosion resistance of U_3Si at 300°C is not seriously affected by irradiation, but the corrosion rate increases rapidly with temperature. Author (NSA)

N69-11027# Argonne National Lab., Ill.
STATISTICAL MODEL OF TWO-ZONE POINT REACTOR SYSTEMS [STATISTICHESKAYA MODEL TOCHECHNYKH DVUKHZONNYKH REAKTORNYKH SISTEM]
B. Kozik et al Jun. 1968 11 p refs Transl. into ENGLISH from Russian Rept. JINR-2828
(ANL-Trans-651) Avail: CFSTI

A two-point system which permits determination of the effects of the reflector upon the noise spectrum and correlation function of neutrons (Rossi α-method) in core-reflector (two-zone) systems is presented. If the two-point model is applied to a one-zone reactor, then this reduces to a consideration of the spatial extension of the reactor and permits an estimate of the upper frequency limit. Proof is presented. NSA

N69-11045# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
TITRIMETRIC AND DIRECT POTENTIOMETRIC DETERMINATION OF THORIUM IN THE PRESENCE OF OTHER IONS [DETERMINAZIONE TITRIMETRICA E POTENZIOMETRICA DIRETTA DEL TORIO IN PRESENZA DI ALTRI IONI]
V. Altemura, A. Canonico, and V. Pompei 1968 28 p In ITALIAN; ENGLISH summary
(RT/CHI(68)20) Avail: CFSTI

A simple and rapid method is described for the direct potentiometric determination of thorium with EDTA in the presence of other ions. The apparatus can be easily remotized and the method usefully employed for routine determinations for irradiated power reactor fuels. Author

N69-11049 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
PROGRAM FOR THE CALCULATION OF THE SUPPORT STRUCTURE OF THE FUEL ELEMENTS IN A NUCLEAR REACTOR [PROGRAMMA PER IL CALCOLO DELLA STRUTTURA DI SOSTEGNO DEGLI ELEMENTI DI COMBUSTIBILE IN UN REATTORE NUCLEARE]
S. Curioni and M. Rossi 1968 23 p ref In ITALIAN; ENGLISH summary
(RT/ING(68)12-PRV-R-(68)9) Avail: CFSTI

In this work we report the logical structure and the conditions of use of a calculation program used to determine the tensions and the deformations in the support structure of the fuel elements in a nuclear reactor. This program is written in Fortran IV; an example of output and the Fortran instruction list are reported in the appendix. Author

N69-11050# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
BEHAVIOUR OF A FAST PULSED REACTOR [COMPORTAMENTO DI UN REATTORE VOLOCE IN REGIME PULSATO]
T. Trombetti 1968 24 p refs In ITALIAN; ENGLISH summary
(RT/ING(68)16-PRV-r-(68)11) Avail: CFSTI

A kinetic study of a fast pulsed reactor is performed for the case in which the reactivity is a periodic function of time and the flux has reached an asymptotic quasiperiodic behaviour. The study is carried out in both cases of constant and non constant delayed neutron source. An evaluation of the conditions for the operation of the control system is given. Numerical results obtained by a computer code are also listed. Author

N69-11066# Gulf General Atomic, San Diego, Calif.
FORT ST. VRAIN PROOF TEST ELEMENT NUMBER ONE
J. R. Hooker, R. J. Grenda, C. S. Luby, and R. G. Mills 12 Jun. 1968 109 p refs
(Contract AT(04-3)-633)
(GAMD-8552) Avail: CFSTI

The materials and processes used in the fabrication of the proof test element, including the characterization of the coated fuel particles and fuel rods, the piggyback irradiation specimens, and the assembly of the element are described. Author (NSA)

N69-11078# Oak Ridge National Lab., Tenn.
CALCULATING CONVECTIVE TRANSPORT AND DEPOSITION OF FISSION PRODUCTS
T. S. Kress and F. H. Neill Sep. 1968 21 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2218) Avail: CFSTI

Some calculational techniques used in the HTGR Fission Product Deposition Program are presented. A method of solution of the differential equations for a Langmuir Adsorption Isotherm surface condition is suggested and approximate numerical results are presented. An exact solution is presented for fission products condensing on a surface. This solution is directly applicable to thermal gradient tubes. These two solutions are shown to be in good agreement with limited experimental data. Author (NSA)

N69-11123# Battelle Memorial Inst., Columbus, Ohio.
INVESTIGATION OF THE INITIATION AND EXTENT OF DUCTILE PIPE RUPTURE Quarterly Progress Report, Apr.–Jun. 1968
Robert J. Eiber, Willard A. Maxey, Arthur R. Duffy, and Thomas J. Atterbury 1 Jul. 1968 23 p
(Contract W-7405-eng-92)
(BMI-1847) Avail: CFSTI

Activities in a program to define defects associated with fractures in typical PWR and BWR primary-coolant piping are reported. During the reporting period failures of A106B pipe were examined. Data are included on 24-in.-dia pipe having 1.70-in.-thick walls. Calculated data are also included on stress intensity as a function of crack length and on flow stress in A106B pipe. NSA

N69-11167# Gulf General Atomic, San Diego, Calif.
LATTICE PHYSICS STUDIES Quarterly Progress Report, Period Ending 31 Mar. 1968
G. D. Trimble, T. Gozani, and C. A. Preskitt 15 Apr. 1968 58 p refs Prepared for EURATOM
(Contract AT(04-3)-167)
(GA-8622; EURAEC-2053) Avail: CFSTI

An experiment designed to include both geometry and density scaling in order to study the effect of a fuel rod cell reentrant hole on the perturbation of neutron spectral measurements is described. The experiment was designed to mock-up a single Pu rod in light water by use of a dummy fuel rod composed of a mixture of Al_2O_3 and Er_2O_3 powders. The techniques, results, and analysis of the reentrant tube perturbation experiment are presented. NSA

N69-11168# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
SUPERCRITICAL LOOP EXPERIMENTAL TEST PROGRAM
Paul Cohen, ed. [1968] 53 p
(Contract AT(30-1)-3843)
(WARD-3843-1) Avail: CFSTI

The design revisions, construction and checkout of the Saxton Supercritical Loop are described. Results are presented of the irradiation in the Saxton Reactor of an Incoloy-800 clad, UO_2 pellet-fueled, seven-rod fuel assembly in supercritical water at 3600 psia and 830–900°F clad temperature. Observations on ammonia dissociation and fission product release from a failed fuel rod are presented. Post-irradiation examination results on the fuel bundle are presented and possible mechanisms for the cladding failure are discussed. Author (NSA)

N69-11186# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
FLUX PEAKING AND SUPPRESSION IN CANDU-BLW FUEL BUNDLES
M. H. M. Roshd May 1968 37 p refs
(AECL-3143) Avail: CFSTI

Experiments were performed in the ZED-2 reactor to determine the flux peaking in the fuel when two 18-element CADNU-BLW fuel bundles were in contact. Three coolants were used: H_2O, D_2O and air. The flux peaking at the end of a fuel bundle in contact with coolant only and the suppression of this peaking by using a stainless steel suppressor of a suitable size were also measured for H_2O and D_2O coolants. Author (NSA)

N69-11190# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
STUDY OF FISSION GAS RELEASE FROM UO_2 SAMPLES IRRADIATED AT VARIOUS DOSES Quarterly Report, Oct.–Dec. 1967
V. Baffigo and G. Frigerio May 1968 12 p Transl. into ENGLISH from Italian
(Contract EURATOM-043-65-TEEI (RD))
(M/549; EURAEC-2039; EUR-3989; QR-9) Avail: CFSTI

Eleven diffusion experiments have been performed on UO_2 specimens (fused and hot-pressed powders and grains; density, 97.9 and 99.0% T.D.) at 1400°C and 12 to 2300 MWd/t. The irradiation dose effect on the release rate parameter, consisting in a decrease of D' with increase of the irradiation dose equal to 1 to 2 orders of magnitude, seems to occur mainly within 100 MWd/t. In very high density UO_2, an increase of D', subsequent to the saturation of its initial decrease, has been observed. This increase seems effective already after a few hundreds MWd/t and brings practically the D' values again to initial levels at about 2000 MWd/t. NSA

N69-11193# Oak Ridge National Lab., Tenn.
HIGH FLUX ISOTOPE REACTOR Quarterly Report, Oct.–Dec. 1967
R. V. McCord and B. L. Corbett 21 May 1968 132 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2243) Avail: CFSTI

The operation history and performance of the high flux isotope reactor are discussed, along with the control and cooling systems. Control plates are described for strain gage tests under cold flow conditions, radiation effects on tensile properties, and

drag effects on scram travel and time of flight. The effects of rod position on static load induced stresses and the radiation effects on the tensile properties of HFIR plate-type are given. The results of high load, low cycle fatigue tests on the bearing lugs are also presented. NSA

N69-11197# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
SNAP-23A, PHASE 1 Quarterly Progress Report, 1 Mar.–31 May 1968
W. B. Henderson 30 Jun. 1968 147 p
(Contract AT(30-1)-3800
(WANL-3800-16; WANL-PR-SS-016) Avail: CFSTI

Progress is reported on the SNAP 23A, the Advanced Terrestrial Radioisotope Power System. Plans are reviewed for the project to investigate the Experimental Mockup System (EMS) failure and corrective measures are discussed and additional testing programs initiated. Systems design work on engineering, mechanical design, stress analysis, thermal analysis, thermoelectric analysis, and materials design support were discussed with the accompanying failures and investigations made during the disassembly. The failure is attributed to a catastrophic corrosion of the power and thermocouple feed through ports of the heat source jacket and short circuiting of the electrical heater within the heat source assembly. Design changes in the base assembly have been made and the projected results of the improvements summarized. The safety criteria were reviewed and additional objectives inserted. NSA

N69-11198# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ISOTOPE PRODUCTION AND AVAILABILITY FROM POWER REACTORS
D. E. Deonigi, R. W. Mc Kee, and D. R. Haffner Jul. 1968 206 p refs
(Contract AT(45-1)-1830)
(BNWL-716) Avail: CFSTI

The projected availability of radioactive and stable isotopes from U. S. nuclear power reactors through the year 1990 is presented. The availability projections are for total spent fuel, U-235, U-236, total plutonium, Np-237, Pu-238, Am-241, Am-243, Cm-242, Cm-244, Pm-147, Ce-144, Cs-137, Sr-90, Kr-85, Ru-106, ^{3}H, ^{99}Tc, Rh-103, stable palladium, stable xenon, stable krypton, and stable ruthenium. Also included is a complete printout of the ISOPRO computer program for the eight different cases that were evaluated. Author (NSA)

N69-11202# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
STUDY OF FISSION GAS RELEASE FROM UO_2 SAMPLES IRRADIATED AT VARIOUS DOSES Quarterly Report, Jan.–Mar. 1968
V. Baffigo and G. Frigerio May 1968 10 p Transl. into ENGLISH from Italian
(Contract EURATOM-043-65-TEEI (RD))
(M/550; EURAEC-2038; EUR-3988; QR-10) Avail: CFSTI

Ten diffusion experiments have been performed on UO_2 pellet specimens (density 92 to 95% T.D.) at 1400°C and 3 to 7000 MWd/t. The diffusion coefficient D' varied from 10^{-13} to 2.4×10^{-9} sec^{-1}. The irradiation dose effect on the release data parameter of xenon, consisting in a decrease of D' with increase of the irradiation dose, has been evaluated within 2 to 3 orders of magnitude by increasing the dose from a few MWd/t to 2000 to 3000 MWd/t. This is true both for pellets of density 92 and 95 percent of theoretical. It has been observed, however, that in more dense pellets the D' coefficient increases after having reached a minimum at the saturation level which, on the contrary, is maintained by less dense pellets. The same behavior of dense pellets has been observed in fused UO_2. However, the difference in density (95% of pellets versus 99% of fused UO_2) seems to influence the saturation value of D' decrease. This value has been evaluated to be a few hundreds MWd/t in fused UO_2 and a few thousands MWd/t in pellets. NSA

N69-11205# Gulf General Atomic, San Diego, Calif.
HELIUM BUOYANCY AND EFFECTS ON ATMOSPHERIC DILUTION
D. B. Sedgley 15 Nov. 1967 24 p refs
(Contract AT(04-3)-633)
(GA-8369) Avail: CFSTI

Calculation of an atmospheric dilution factor to be applied to radioactivity contained in a cloud of buoyant gas released during the course of a reactor plant accident depends on the amount of such gas that becomes available for dispersion in the atmosphere. A sample calculation is given based on the maximum accidental helium leak from the Fort St. Vrain reactor plant. Equations for behavior of buoyant gas clouds are given and solved. Effects of atmospheric density lapse rate, wind speed, building downwash, atmospheric stability conditions, and actual cloud outflow velocity on effective atmospheric dilution are discussed. NSA

N69-11211# Societa Ricerche Impianti Nucleari, Saluggia (Italy).
CALCULATION OF SPECIFIC BURNUP IN A NUCLEAR FUEL PELLET IRRADIATED IN AN ORDINARY WATER REACTOR Special Technical Report Number 1
P. G. Ovario and J. Vajra Jan. 1968 42 p refs
(Contract EURATOM-043-65-TEEI (RD))
(S/534; EURAEC-2003; EUR-3794) Avail: CFSTI

The calculation procedure adopted to evaluate the specific burnup attainable in a natural or slightly enriched uranium or uranium oxide pellet, to be irradiated in a recess in the Avogadro RS-1 reactor, is described. The irradiation period is divided into consecutive partial periods, in each of which the neutron distribution and the composition are treated as constant as regards the reaction rate. The variations of the pellet composition with time are assumed to be due to variations in the concentrations of the nuclides ^{235}U, ^{238}U and ^{239}U only. The calculation is programmed for SORIN's Elea 6001 computer. Author (NSA)

N69-11226# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
TWO PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES Quarterly Progress Report, 1 Jan.–31 Mar. 1968
Jun. 1968 12 p refs
(Contract AT(04-3)-189)
(GEAP-5497; QPR-10) Avail: CFSTI

In order to determine the nature of the liquid film, measurements will be made in two-phase steam-water flow at 600 to 1400 psia. The needle contact and conductance methods are available for measuring the film thickness. The porous sinter wall method of sucking off the liquid film and the scoop method are available for measuring the liquid film flow rate. Although the conductance method and porous sinter wall method appear to be the better methods of measuring film behavior, all available techniques will be further examined in a low pressure plexiglass channel. Author (NSA)

N69-11231# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
PHYSICAL PROPERTIES OF SOME PLUTONIUM CERAMIC COMPOUNDS: A DATA MANUAL
B. J. Seddon, comp. 18 Dec. 1967 64 p refs
(TRG-REPORT-1801) Avail: CFSTI

The best available data on the physical properties of plutonium compounds of interest as fuel materials are tabulated. These are

the dioxide, monocarbide, mononitride, monosulphide, and monophosphide of Pu, $(UPu)O_2$, (UPu)C, (UPu)N, and the Pu silicides. Author (NSA)

N69-11233# General Electric Co., Schenectady, N. Y. Atomic Power Equipment Dept.
TRANSITION BOILING HEAT TRANSFER PROGRAM Final Program Summary Report, Feb. 1963–Oct. 1967
E. E. Polomik Oct. 1967 109 p refs
(Contract AT(04-3)-189)
(GEAP-5563; EURAEC-1957) Avail: CFSTI

Heat transfer data and high-speed motion pictures were obtained for water at critical heat flux, throughout the transition boiling range, and in film boiling. Data were obtained with smooth and specially roughened surfaces with one-, two-, and three-rod heaters. Most of the heat transfer data with single-rod heaters were obtained with annular flow and the inner boundary heated. The balance of single-rod heater data were obtained with flow inside heated tubes for the purpose of measuring bulk mean super-heated steam temperatures. The test parameters in general were in the ranges: 600 to 1400 psia pressure, 0.25×10^6 to 2.0×10^6 lb hr-ft^2 mass velocity, and 20 to 100 wt % steam quality. Analytical results were obtained for temperature oscillations at the inner wall of a tube with uniform heat generation in the wall and external cooling. A typical nuclear fuel rod was analyzed for temperature oscillations at the external cladding surface. The detailed results and conclusions are summarized together with a brief description of the test equipment. Author (NSA)

N69-11243# Institutt for Atomenergi, Halden (Norway).
IRRADIATION EXPERIENCE WITH THE FIRST URANIUM DIOXIDE ALUMINUM CLAD FUEL ASSEMBLY TESTED IN HBWR
K. Videm, S. Aas, A. Hanevik, and E. Jensen May 1968 31 p refs Supported in part by Govt. of Norway and Neth.
(HPR-100) Avail: CFSTI

The reactor experience with the first Al clad fuel element tested under HBWR conditions is described. The cladding alloy used had the following composition: 1% Ni, 11% Si, 0.5% Fe, 0.8% Mg, 0.1% Ti, balance Al. After a total irradiation time of 140 days, corresponding to an integrated power of 730 MWd/t at two channel power levels, one of the stringers failed at two bulbshaped distortions, one at either end of the stringer. The primary reason for the failure was corrosion of accidental inclusions of pure Al in the Al alloy cladding. The bulb-shaped distortions were caused by reaction between the thermal isolation pellets of MgO and the in-leaked water. The general behavior of the other stringers was satisfactory. Based on the experience with these elements two new assemblies have been made and are being irradiated. The maximum heat fluxes are 65 W/cm^2 and 140 W/cm^2 respectively, and the integrated powers 5900 MWd/t and 5600 MWd/t as of August 1968. Author (NSA)

N69-11244# Gulf General Atomic, San Diego, Calif.
GAPER: A TRANSPORT PERTURBATION THEORY PROGRAM
D. A. Sargis 26 Apr. 1968 83 p refs
(Contract AT(04-3)-167)
(GA-8667) Avail: CFSTI

A computer program GAPER has been written to evaluate reactivity coefficients in reactor assemblies using first order transport perturbation theory. Scalar neutron fluxes and currents, as computed by S_n transport calculations are utilized with leakage and anisotropic scattering effects treated in a P_1 approximation. GAPER computes contributions to the change in inverse multiplication factor $\Delta(1/k)$ due to perturbations in the individual capture, net fission, total scattering, (n,2n), inelastic scattering, and leakage cross sections. The program assumes that the fluxes and currents are separable and may be combined in an elementary synthesis scheme for two- and three-dimensional problems. A multidimensional prompt neutron lifetime calculation is also available. Numerical results compare favorably with transport calculations and are superior to all diffusion theory problems considered. Computer running times for the perturbation method are much faster than direct transport or diffusion theory calculations. Author (NSA)

N69-11245# Institutt for Atomenergi, Halden (Norway).
DEVELOPMENT OF IN-PILE BURN-OUT DETECTORS
K. Schenk Mar. 1967 35 p refs
(HPR-77) Avail: CFSTI

Three types of burn-out detectors are developed for in-pile use: measurement of fuel can elongation with a differential transformer; measurement of the electrical resistance of the fuel canning; and measurement of the insulation resistance of a coaxial cable installed in grooves in the fuel pellets. In-pile tests and application show the detectors to be reliable, simple to use, and capable of protecting fuel assemblies against damage due to fuel canning overheating at critical heat flux conditions. Author (NSA)

N69-11251# General Electric Co., Pleasanton, Calif. Nucleonics Lab.
PLUTONIUM SUBCRITICAL EXPERIMENT PROGRAM Final Report, 31 Oct. 1967
J. G. Carver Dec. 1967 139 p refs Prepared for EURATOM
(Contract AT(04-3)-189)
(GEAP-5357; EURAEC-1989) Avail: CFSTI

A pressurized subcritical facility has been constructed with its main pressure vessel directly above a 28-inch (71 cm) diameter fission source plate centered on the top face of the General Electric Nuclear Test Reactor. Fuel lattices with water-to-fuel ratios of 2:1 and 3:1, having an effective multiplication of 0.97 at 70°F, were constructed from Zircaloy-2-clad mixed-oxide fuel rods containing pellets of 98.5% natural UO_2 and 1.5% PuO_2 (with a ^{240}Pu content of 16.33%), having an active fuel diameter of 0.491 inch (1.25 cm), and an active length of 24 inches (60.96 cm). With the Nuclear Test Reactor at full power (and the fission plate at less than 1 kW) thermal neutron fluxes in the centers of these lattices, at 70°F, were on the order of 6×10^8/cm^2-sec. These lattices were irradiated in the pressurized facility at a variety of temperatures and pressures up to 540°F and 1050 psig to determine nuclear reaction rates at various points within the unit cell of the lattice. Author (NSA)

N69-11263# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.
SODIUM COMPONENTS DEVELOPMENT PROGRAM MASS TRANSFER INVESTIGATIONS IN LIQUID METAL SYSTEMS Quarterly Progress Report, Jun.–Aug. 1967
Sep. 1967 68 p refs
(Contract AT(04-3)-189)
(GEAP-5546; QPR-2) Avail: CFSTI

Research is reported on the corrosive effects of liquid sodium, pressure, and exposure times on fuel element cladding materials for LMFBR; Incoloy 800; and Type 304, 316, and 347 stainless steels. NSA

N69-11273# Los Alamos Scientific Lab., N. Mex.
ENERGY DEPENDENCE OF AVERAGE KINETIC ENERGY OF FISSION FRAGMENTS
V. I. Bol'shov, V. F. Kuznetsov, G. N. Smirenkin, S. B. Ermagambetov, and V. N. Okolovich [1968] 11 p refs Transl. into ENGLISH from the Russian Report FEI-49
(LA-TR-68-19) Avail: CFSTI

Results are given of the relative measurements of average kinetic energy of fragments realized in the fission of ^{233}U and ^{235}U induced by neutrons with energy up to 2 MeV. Various ideas are discussed linking the origin of irregular measurements of the quantity investigated with the discrete spectrum structure of fission channels. Results of the experiment can be explained in terms of alternative propositions concerning the nature of the relation between deformation and nucleon degrees of freedom in the fissionable nucleus. Author (NSA)

N69-11276# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
PREPARATION AND EVALUATION OF AN ADU-DERIVED CERAMIC GRADE URANIUM DIOXIDE POWDER
E. J. Ramm and S. T. Quaass Mar. 1968 38 p refs
(AAEC/TM-439) Avail: CFSTI

The method and equipment used to prepare a ceramic grade uranium dioxide powder are described, together with relevant characteristics of the intermediate and final products. The method chosen followed the ammonium diuranate route involving continuous precipitation from uranyl nitrate solution using gaseous ammonia. Conversion of the ammonium diuranate to uranium dioxide was effected by heating in a hydrogen/nitrogen atmosphere and following this with a low temperature stabilisation treatment. Various physical tests were carried out on the resultant powder, and finally, specimens were pressed and sintered over a wide range of pressures and temperatures. The tests indicated that the powder was sinterable and that the method of preparation produced a ceramic grade powder exhibiting consistent properties and behavior. Author (NSA)

N69-11279# Eidgenoessiches Institut fuer Reaktorforschung, Wurenlingen (Switzerland).
APPLICATION OF LIAPUNOV'S SECOND METHOD TO THE STUDY OF THE STABILITY OF NUCLEAR REACTORS [APPLICATION DE LA SECONDE METHODE DE LIAPUNOV A L'ETUDE DE LA STABILITE DES REACTEURS NUCLEAIRES]
G. Burnand Nov. 1967 83 p refs In FRENCH
(EIR-125) Avail: Issuing Activity

A brief summary of Liapunov's second method is given, the basic reactor kinetics equations are stated. Reactor stability criteria are developed. The stability criteria developed by Welton, Smets, and Lur'e-Popov are considered briefly. Use of the Liapunov function for formulation of stability criteria is discussed; basic theorems are given. Stability coefficients and solutions to the stability equations are developed. Explicit conditions for the existence of real solutions are given. Stability limits are estimated. A sample problem is included. NSA

N69-11281# Oak Ridge National Lab., Tenn.
THE OAK RIDGE RESEARCH REACTOR: A FUNCTIONAL DESCRIPTION
T. P. Hamrick and J. H. Swanks Sep. 1968 261 p refs
(Contract W-7405-ENG-26)
(ORNL-4169(Vol. 1)) Avail: CFSTI

A description of the ORNL Research Reactor is given. Included are details of: cooling system, layout diagrams, cooling tower, fan system, control systems, safety, reactor building, containment systems, fuel elements, test holes, design parameters, pressure vessels, radioactive waste handling, nuclear and heat transfer characteristics, electrical systems, safety analysis, and auxilliary and emergency systems. NSA

N69-11282# Gulf General Atomic, San Diego, Calif.
FAST REACTOR SPECTRUM MEASUREMENTS Annual Progress Report, Period Ending Apr. 30, 1968
C. A. Preskitt, J. M. Neill, and J. C. Young 3 Jun. 1968 48 p refs
(Contract AT(04-3)-167)
(GA-8715) Avail: CFSTI

A description of the STSF split-table assembly is presented. The first core loading for the assembly, designated STSF-1, is described. Description of the experimental electronics is presented. Data reduction procedures are analyzed. Spectra measurements for intermediate and fast neutrons are presented. NSA

N69-11283# Oak Ridge National Lab., Tenn.
AN ANALYTIC SOLUTION OF THE MULTILAYER PROBLEM IN THE BUILDUP CALCULATION
W. Zumach [1968] 14 p refs Transl. into ENGLISH from Atomkernenergie (Munich), v. 12, 1967 p 20–24
(ORNL-TR-1949) Avail: CFSTI

Some new approximations are developed and also an exact analytical solution of the multilayer problem is presented. The method of analytic continuation connects the different material buildups using two boundary conditions: the continuity of dose (left border) and the transition of the true buildup to the material buildup in the case of very large thickness (right border). Realizing the buildup in any layer to be partly originated in the foregoing layer, a simple mode of continuation is obtained. A little more complicated version of the continuation method regards the buildup in any region to be composed of two or more buildups of the foregoing regions. Applying these boundary conditions ε values are calculated which will weight the material buildups of the different slabs. Provided buildup and energy spectrum are analytical functions, an exact solution in plane geometry is achieved in two different ways. A differential dose in an energy interval [E,E + dE] of the spectrum S(E) is said to be originated by a monoenergetic point source of energy E. Author (NSA)

N69-11293# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Servizio Documentzaione.
AN AUTO-OPTIMIZED MONTE CARLO METHOD FOR MORE STATES APPLIED TO THE CALCULATION OF DETECTION EFFICIENCY [UN METODO DI MONTE CARLO AUTO-OTTIMIZZATO A PIU STADI APPLICATO AL CALCOLO DI UN'EFFICIENZA DI RIVELAZIONE]
R. Baldini-Celio, B. Ballico-Lay, and M. A. Mencuccini Spano 12 Sep. 1968 12 p refs In ITALIAN /ts Nota Interna No. 414
(LNF-68/54) Avail: CFSTI

A Monte Carlo procedure is described for rapidly calculating the error detection efficiency. The advantages of this method are: (1) simplicity, (2) capability to resume calculations after being interrupted, and (3) capability to obtain, at the same time, error and efficiency estimates. One of the disadvantages of this system is the large statistical error of 10%. The Monte Carlo auto-optimized procedure (MCAO) is based on the information of a Monte Carlo solution, and develops from this state into more successive states. Mathematical calculation using weighted factors, and MCAO are included. The program is in FORTRAN language for IBM 7040 computer. Transl. by F.O.S.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N69-10016 Minnesota Univ., Minneapolis.
A STUDY OF PARAMETRICALLY EXCITED DYNAMICAL SYSTEMS
Gene Willard Hemp (Ph.D. Thesis) 1967 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-17276

Nonlinear holonomic dynamical systems subjected to various types of parametric excitation are studied. The effect of high frequency and small amplitude parametric excitation on a dynamical system manifests itself in an effective potential energy which determines new steady state motions or equilibrium positions for the averaged system. This is obtained by a rigorous and direct method using the Hamiltonian formulation of the equations of motion and the method of averaging of Bogoliuboff and Mitropolsky. The results obtained extend previous results to include nonlinear damping effects and are now applicable to gyroscopic systems as well as non-gyroscopic systems. Dissert. Abstr.

N69-10053 State Univ. of Iowa, Iowa City.
A GENERALIZED HAMILTON'S PRINCIPLE AND ITS APPLICATION TO ELECTROMAGNETIC THEORY
Gaston Alberto Arredondo (Ph.D. Thesis) 1967 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-898

A generalized Hamilton's principle is postulated by combining the non-preservative system with another system, called the adjoint, which is defined as having negative non-preservative effects. Equivalently, the adjoint system may be considered as being obtained by time-reversing the original system. The generalized Hamilton's principle is applied to some non-preservative electromagnetic systems. The only non-preservative effect considered is dissipation. Resonance is lossy cavities and propagation in lossy waveguides are analyzed. It is shown that the generalized Hamilton's principle leads to the differential equations governing the fields, and that the conditions at boundaries are natural boundary conditions of the Lagrangian approach. It is also shown that the generalized action functional can be used to derive variational principles for the eigenvalues of the problems. It is found that the generalized Hamilton's principle provides a simple procedure for obtaining a variational formulation of problems that may be too complex for a complete, closed solution. Dissert. Abstr.

N69-10089 Stanford Univ., Calif.
A STUDY OF GAS-SURFACE INTERACTIONS EMPLOYING A CONTINUUM MODEL OF THE SOLID
Lawrence Bertrand Scott, Jr. (Ph.D. Thesis) 1967 174 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 67-17501

Closed form analytical results for rarefied, electrically neutral gas surface energy exchange are derived for a simple model employing a one dimensional elastic continuum representation of the solid with (1) a truncated harmonic potential and (2) a Morse potential for the interaction between the gas atom and the surface of the continuum. The results consist of formulas for the thermal accommodation coefficient and critical trapping energy. With the truncated harmonic potential, the continuum gives practically the same values of accommodation coefficient and critical trapping energy as the discrete lattice for cases in which the collision frequency is considerably smaller than the cut-off frequency of the lattice. For the inert gases interacting with tungsten, nickel, and platinum, a continuum model of the solid should be a fairly good approximation of the actual discrete lattice. With a Morse potential, the variation of accommodation coefficient with temperature is qualitatively correct for the continuum solid model, but the accommodation coefficient values appear to be considerably larger than those predicted by Trilling for a discrete lattice. Dissert. Abstr.

N69-10106 Rensselaer Polytechnic Inst., Troy, N. Y.
THIN FILM STUDIES BY ELECTRON PROBE MICROANALYSIS AND TRANSMISSION ELECTRON MICROSCOPY
Gary Judd (Ph.D. Thesis) 1967 145 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-830

The interaction of an electron beam with a thin metal foil was analyzed by an electron microprobe accessory of an electron microscope, and solutions for the above problems were derived and experimentally verified. The finely focused electron beam of an electron microscope was used as the source for the incident radiation of the microprobe. The high resolution electron optics of the microscope permitted concurrent imaging of the area examined. Thus, both the characteristic intensity generated and the exact distribution present in a particular microvolume were investigated. The intensity distribution of the electron beam and the effect of segregation within the beam were studied using a model system consisting of silver powder particles (1 μ) on a carbon film. A theoretical model explaining the intensity variation as a function of the powder particle position within the beam was derived, and a computer program was written to perform the necessary calculations. This method was extended to explain observed intensities for several configurations of precipitates in an aluminum-1 ^{a}/o germanium binary alloy. Dissert. Abstr.

N69-10107 Virginia Polytechnic Inst., Blacksburg.
FOURIER-HERMITE REPRESENTATION OF THE ONE-DIMENSIONAL VLASOV EQUATIONS
Frederick Cyril Grant (Ph.D. Thesis) 1967 65 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-2046

The simultaneous Fourier series–Hermite series transformation of the coordinate-velocity space is investigated as an analytical and numerical technique for the solution of the one-dimensional nonlinear Vlasov equations. Difficulties in coordinate-velocity space associated with entropy conservation make transformations from this space desirable for numerical work. The transformation leads to a doubly infinite set of ordinary differential equations for the time development of the expansion coefficients of the doubly infinite expansion. For numerical work the double expansion is truncated to dimensions suitable for high-speed digital computers. A principal numerical advantage of the Fourier–Hermite transformation is that simultaneous ordinary, rather than simultaneous partial differential equations need be solved. Dissert. Abstr.

N69-10108 Georgetown Univ., Washington, D. C.
LIGHT DIFFRACTION BY MEANS OF FREQUENCY MODULATED STANDING SOUND WAVES
Russell Glen Groshans (Ph.D. Thesis) 1967 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-1916

This research was undertaken (1) to more fully understand the physical processes which occur when a light beam interacts with the sound field created by a standing ultrasonic wave; (2) to investigate the possibility of using a frequency modulated standing ultrasonic wave to modulate a monochromatic light (laser) and thus create a practical optical communications technique; and (3) to determine the effectiveness of such an optical communications technique over long pathlengths (715 meters). The research was limited to (near) orthogonal light and sound beam intersections and to frequencies in the range of 1-20 MHz. The effects of varying the standing wave ratio were studied. The diffracted light relative intensities and frequency spectra were investigated as a function of the sound pressure (related to the high voltage of the transmitter). Dissert. Abstr.

N69-10111*# Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.
RESEARCH IN THE CONVERSION OF VARIOUS FORMS OF ENERGY BY UNCONVENTIONAL TECHNIQUES Status Report for Period Ending 30 Jun. 1968
Manfred Altman Jun. 1968 78 p refs
(NASA-CR-97473; INDEC-SR-14) Avail: CFSTI CSCL 20

A transient solution to the heat conduction equation in a three layer composite cylinder was developed assuming perfect thermal contact between interfaces. Thermoelectric power, Hall coefficient, electrical conductivity, microhardness, and optical reflection measurements were made on $CuCd_2InSe_4$ and $AgCd_2InTe_4$. Data on the structure of tungsten films, on the effect of gas pressure on structure, and on tunneling were analyzed and summarized. Five porous ceramics and two millipore membranes were analyzed to define thermal transpiration flow, isothermal permeability, and heat conductivity. MHD measurements were made using a conducting fluid of liquid Hg with Na metal additive to increase wettability. Definite positive effects from the shape of the Pt Fermi surface were obtained; the results explained a large part of the structure of the Pt micrograph. Experimental apparatus was assembled for the purpose of obtaining transient overpotential data of a redox system (K ferricyanide and K ferrocyanide) on a rotating disk. Progress in specific areas of fuel cell design and performance are summarized. B.P.

N69-10136 Connecticut Univ., Storrs.
SPEED OF SOUND IN SINGLE COMPONENT, TWO-PHASE MIXTURES
Roger Paul Caron (Ph.D. Thesis) 1967 92 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-1325

The study of the speed of sound in single component, two-phase mixtures is explored both analytically and experimentally. Previous major contributions, both analytical and experimental, are discussed in detail, with special emphasis placed upon equilibrium criteria in two-phase, wet mixtures. The problems experienced in measuring the speed of sound are enumerated, and the development of testing equipment to surmount these problems is presented. Special attention is given to the operation of the acoustic interferometer and the development of the uniform flow calorimeter. The study is concluded by reporting the results of speed of sound measurements performed on Freon-113 at 80°F and qualities ranging from 30% to 100%. The speed of sound is shown to remain constant for all values of quality tested and to equal the speed of sound in the dry saturated vapor. Dissert. Abstr.

N69-10146# Michigan Univ., Ann Arbor. Inst. of Science and Technology.
OPTICAL PROCESSING BY MEANS OF LENSLESS CORRELOGRAPHY Final Letter Report
Aug. 1968 43 p refs
(Contract N00140-67-C-0162)
(AD-673743; Rept.-08601-8-L) Avail: Issuing Activity CSCL 20/6

The work on this contract has been concerned with optical processing by means of lensless correlography. This optical technique, sometimes known as the Meyer-Eppler effect and as Robertsons method, was first used in crystallography to obtain the Patterson function. The work included development of a technique of obtaining multichannel correlation functions experimental determination of angular radiation from a CRT spot, investigation of methods of commutating and presenting array data on a CRT, and development of a method of frequency indication by lensless correlography. During the investigations two separate imaging methods were found to be special cases of lensless correlography. Author (TAB)

N69-10330 Minnesota Univ., Minneapolis.
ADIABATIC DESORPTION OF POROUS MATERIALS BY CONDITIONED AIR STREAM
Prem Chand Jain (Ph.D. Thesis) 1967 406 p
Avail: Univ. Microfilms: HC $18.45/Microfilm $5.20 Order No. 68-1537

A fundamental study is made of the process of adiabatic desorption of porous materials in deep stationery beds. The present study takes into account: 1. Simultaneous heat and mass transfer between solid and air in its vicinity. 2. A finite mass transfer resistance between solid surface and air stream. 3. A variable surface moisture content of the solid. The analytical procedure is based on the following assumptions: 1. Entering air is at a constant temperature, humidity ratio, and velocity. 2. Initially the temperature and moisture content of the solid is uniform within each particle and throughout the bed. 3. Solid particles can be treated as spheres with equal surface area. 4. The mechanism of internal moisture movement is liquid diffusion; diffusion coefficient varies only with the temperature of solid. 5. Average solid temperature is the temperature within and on the surface of the solid particle. 6. No transverse gradients exist in temperature and moisture content of solid particles and air. Dissert. Abstr.

N69-10375*# Wyle Labs., Inc., Huntsville, Ala. Testing Div.
NONLINEAR ACOUSTICS
F. V. Bracco Aug. 1967 52 p refs
(Contract NAS8-21060)
(NASA-CR-98085; WR-67-7) Avail: CFSTI CSCL 20A

Nonlinear acoustics problems are first defined as those problems which require nonlinear equations for their descriptions. Mass, momentum, and energy conservation equations are then derived with particular attention paid to the introduction of first, second and bulk viscosity coefficients. The equation of state is briefly introduced and the assumptions made on the nature of acoustical processes (adiabatic, isentropic, etc.) are analyzed and classified. The assumptions made to derive Burgers' equation for plane nonlinear waves are then listed. Some solutions of Burgers' equations are reported and their range of practical validity pointed out. An equation for cylindrical, spherical and exponential horn waves, equivalent to Burgers' equation for plane waves and including it as a special case, is then derived. The solution of this equation for the case of exponential horn is given in proper terms of the solution of Burgers' equation. It is also suggested that the numerical solution of this equation for spherical and cylindrical waves would help interpretation of the nature of shocklets observed close to jet exhausts. Finally the important diffusion coefficient is studied again with the object of explaining the way it should be determined. Author

N69-10531# National Research Council of Canada, Ottawa (Ontario).
AN INVESTIGATION OF THE NEAR NOISE FIELDS OF A CHOKED AXISYMMETRIC AIR JET
R. Westley and J. H. Woolley Jun. 1968 39 p refs Paper Presented at AFOSR-UTIAS Symp. on Aerodyn. Noise, Toronto, 20 May 1968
(NRC-10352; LR-506) Avail: CFSTI

An experimental investigation was completed of the near sound field of a choked axisymmetric air jet of 2.25 in diameter. The results include surveys of the sound pressure levels in the area surrounding the jet and the identification of various screech frequencies. A schlieren system with stroboscopic spark synchronization was used to photograph an axisymmetric mode and a spiralling mode of the jet oscillations. Author

N69-10729 Colorado State Univ., Fort Collins.
DESIGN AND PERFORMANCE OF A MICROSCOPE HOT STAGE FOR CRYSTAL GROWTH STUDIES
John Kitterman and D. R. Winder [1968] 4 p Presented at the Ann. Meeting of the A.P.S., Chicago, 1968
Avail: Issuing Activity

Details are given on a hot stage developed to observe the relationships between crystal growth rate, temperature, and vapor pressure. The optical window of sapphire accommodates a cooled long-working distance, 40X objective, and the specimen is mounted just below this window on a rod which can be manipulated in order to keep a growing face in view of the microscope. Temperature measurement and control are accomplished by thermocouples or thermistors located in an equivalent sample position, in the charge, and on the sample support rod. Controlled electrical power is introduced through two independent heating coils, and cooling of the chamber, cover, and objective shield is done with circulating water or gas. Author

N69-10889*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
HIGH-FIELD ELECTROMAGNETS AT NASA LEWIS RESEARCH CENTER
James C. Laurence Washington Nov. 1968 49 p refs
(NASA-TN-D-4910) Avail: CFSTI CSCL 20C

The design, construction details, and performances are described of conventional, water cooled copper magnets and cryogenically cooled (superconductive and nonsuperconductive) magnets with field strengths of 3 to 20 teslas. The devices which are used to power and control the magnets are also described. They include a homopolar generator, transformer–rectifier system, and flux pump. Author

N69-10928# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DEVELOPMENT OF A LONG SPARK AND LIGHTNING
I. S. Stekol'nikov et al 20 Mar. 1968 27 p refs Transl. into ENGLISH from Tr. Energ. Inst., Izd. AN SSR (Moscow), 1966 p 97–110
(AD-675456; FTD-MT-24-46-68) Avail: CFSTI CSCL 20/3

To increase the understanding of the growth process of long sparks, laboratory studies were conducted. In these image-converter tube graphs were constructed using an electron-converter tube with light amplification. To record the discharge current and voltage in the gap, a high speed electronic oscillograph was used. High optical sensitivity permitted a sharp focusing of the weak light fluxes of the initial spark stages. These spark studies were conducted with three different gap arrangements. Author (TAB)

N69-10930# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTICAL PROPERTIES OF THICK LAYERS OF A UNIFORM DISPERSING MEDIUM [OPTICHESKIE SVOISTVA TOLSTYKH SLOEV ODNORODNOI RASSEIVAYUSHCHEI SREDY]
G. V. Rozenberg 25 Jan. 1968 38 p refs Transl. into ENGLISH from Akad. Nauk Belorussk. SSR, Inst. Fiz., Spektroskopiya Svetorasseivayushchikh Sred (Minsk), 1963 p 5–36
(AD-674944; FTD-MT-24-310-67) Avail: CFSTI CSCL 20/6

The article shows that an equation of transfer actually allows in a number of cases effective, approximate analytical solution, in which all properties of the environment are taken into account by a small number of empirical constants. The relationships obtained permit solving with rather high accuracy a very broad class of applied problems from many diverse fields. Finally, the obtained relationships create a theoretical basis for the formulation and solution of inverse problems of the theory of light distribution in dispersing media and a basis for the creation and development of methods of quantitative spectral analysis of dispersive substances. The author emphasizes that the solutions obtained pertain exclusively to monochromatic radiation. TAB

N69-10975# National Research Council of Canada, Ottawa (Ontario).
THE EFFECT OF THE COLOUR OF THE OBJECT ON THE PHOTOGRAMMETRIC REFRACTION AND THE RESOLUTION OF THE IMAGE
I. F. Kushtin 1968 13 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Geod. i Aerofotos. (Moscow), no. 5, 1966 p 75–84
(NRC-TT-1333) Avail: CFSTI

Statistical determinations of photogrammetric refraction are presented which focus on the effect of the color of the object being photographed on photogrammetric refraction and the resolution of the image are reported. S.C.W.

N69-10976*# Michigan Univ., Ann Arbor. Radar and Optics Lab.
OPTICAL PROCESSING TECHNIQUES Final Report, 1 Mar. 1967–29 Feb. 1968
Oct. 1968 115 p refs
(Grant NGR-23-005-235; Contracts AF 33(615)-3100; AF 33(614)-1452; DA-23-043-AMC-00013(E))
(NASA-CR-97741; Rept.-8688-3-F) Avail: CFSTI CSCL 20F

Applications of optical processing techniques and holography were studied. The report includes studies of holographic information reduction, diffraction efficiency of photographically recorded interference patterns, recent advances in contour holography, hologram interferometry of transparent media, propagation through turbulent media, and the log-normal random process. Analytical and experimental results of a new technique for reducing the information content of holographic records are presented. Techniques for improving the diffraction efficiency of photographically recorded interference patterns and a new two-frequency contouring technique are described. The use of holographic interferometry to measure the index of refraction of homogeneous media and application to heat and mass transfer and related fields has been initiated. Author

N69-10986
ON THE DESTABILIZING EFFECT OF FRICTION ON THE STABILITY OF NONCONSERVATIVE ELASTIC SYSTEMS
N. I. Zhinzher [1968] 6 p refs Transl. into ENGLISH from Inzh. Zh. Mekh. Tverdogo Tela, no. 3, 1968 p 44–47
Avail: CFSTI

A general study is presented of destabilization conditions in distributed and discrete elastic systems because of vanishingly small friction. A dynamic method of examining elastic system stability results in the formulation of a boundary value problem. Characteristic equations are derived for this problem, and for a nonconservative elastic system with n degrees of freedom in the presence of dissipative forces. Also considered is the case of a cantilever rod loaded at the free end by a tangential force. It was found that the presence of external friction raises the stability in nonconservative systems; the presence of vanishingly small Voight friction, and friction corresponding to a linear standard viscoelastic material, results in destabilization. M.G.J.

N69-11091# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Heisse Chemie.
X-RAY FLUORESCENCE ANALYSIS OF URANIUM AND PLUTONIUM IN NUCLEAR FUEL SOLUTIONS [ROENTGENFLUORESZENZANALYTISCHE BESTIMMUNG VON URAN UND PLUTONIUM IM KERNBRENNSTOFFLOESUNGEN]

Dieter Ertel and Werner Wettstein Mar. 1968 27 p refs In GERMAN
(KFK-747; EUR-3728.d) Avail: CFSTI

By intensity measurements of the L_α line, uranium and plutonium can be determined in aqueous and organic solutions in the presence of one another with thorium serving as the internal standard. The analysis region ranges from 0.003 to 10 mg U, Pu/ml. The sensitivity of the method is 10^5 impulses/mg U, Pu/ml. For extreme U/Pu concentration ratios and in the presence of large amounts of impurities, background measurements on each sample are necessary. For rapid determination of uranium and plutonium in pure fuel solutions a routine method was developed. In the optimum measuring region the standard deviation is about ±1%.The time requirement for a single determination is about 15 min and for series analyses about 5 to 10 min. Author (NSA)

N69-11118# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
CLOSED SPATIALLY PERIODIC MAGNETIC CONFIGURATIONS WITH MINIMUM B
V. M. Glagolev 1967 44 p In RUSSIAN; for ENGLISH transl. see Princeton Univ., N. J. Rept. MATT-Trans-58
(IAE-1451; MATT-Trans-58) Avail: CFSTI

Closed magnetic traps with a minimum B and consisting of identical sections of magnetic fields stable at certain cross sections were studied. The minimum B of the system was obtained by extending central lines of force as compared to peripheral. Author (NSA)

N69-11125# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
CALCULATION OF POLE PROFILES FOR THE DESIGN OF PARTICLE ACCELERATION MAGNETS. CURRENT AND CONFORMAL REPRESENTATION METHODS [CALCUL DE PROFILS POLAIRES DESTINES A DES AIMANTS. METHODE DES COURANTS ET METHODE DES TRANSFORMATIONS CONFORMES]
Salah Jaidane (Ph.D. Thesis--Paris Univ., Orsay) Apr. 1968 151 p refs In FRENCH
(CEA-R-3238(REV)) Avail: Issuing Activity

Two methods are used to determine the shape of the poles in magnets, for a given field distribution in the air-gap. The principle of the first method consists of creating the desired law of field by means of current sheets in which one can adjust the density given in a polynomial form. For the right distribution of these currents, the equipotential corresponding to the magnetic potential of the excitation coils is calculated. The pole profile of the H or C magnet identified with this equipotential line will finally take place of the distribution of the current sheets used in the calculation. Steel permeability is assumed to be infinite and Foucault current effects are neglected in the case of variable fields. The second method consists of finding a conformal representation that maps the pole profile plane upon the upper half of another plane where the equipotentials are two half straight lines, and where the field problems are easier to solve. Steel permeability is also considered to be infinite and the coils far from the pole faces. Author (NSA)

N69-11130# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A STUDY OF NONLINEAR OSCILLATORY SYSTEMS WITH MANY DEGREES OF FREEDOM IN THE PRESENCE OF RANDOM PERTURBATIONS [ISSLEDOVANIYE NELINEYNYKH KOLEBATEL'NYKH SISTEM SO MNOGIMI STEPENYAMI SVOBODY PRI NALICHII SLUCHAYNYKH VOZMUSHCHENIY]
V. G. Kolomiyets 22 Sep. 1967 10 p refs Transl. into ENGLISH from Ukr. Mat. Zh. (Kiev), v. 14, no. 1, 1962 p 407–411
(AD-675236; FTD-HT-23-772-67) Avail: CFSTI CSCL 21/1

Real systems are always subject to the mutual action of systematic and random perturbations. Actually, purely harmonic oscillations do not exist. Oscillations are actually modulations; their amplitude and phase change slowly in time. The problem of investigating the mutual action of random forces on nonlinear oscillatory systems is realized by reducing the real random process to a process without a time lag and without using the Fokker, Plank and Kolmogorov equations. In the article, the behavior of the amplitude and phase of an equivalent oscillatory system is examined in the case when the system is under the action of stationary random perturbations, upon which a change of amplitude and phase is presented as the Markov process. The result is the statistic description of an oscillatory system under single-frequency conditions. Author (TAB)

N69-11140# Brookhaven National Lab., Upton, N. Y.
LINE HARMONICS AT THE AGS
E. B. Forsyth 8 Jul. 1968 24 p refs
(BNL-12691) Avail: CFSTI

Reasons and possible solutions for the harmonic components present on the voltage waveform of the power feeder for the AGS are given. The results of tests using a model filter trap are also given. The filter described is capable of producing significant reduction in the line voltage distortion experienced on the AGS feeder; also the filter allows a 15 to 20% increase in current at distribution points to which it is connected. Author (NSA)

N69-11177# Radiation Research Associates, Inc., Fort Worth, Tex.
MONTE CARLO ANALYSIS OF SEARCHLIGHT SCATTERING MEASUREMENTS
Michael B. Wells 31 May 1968 23 p refs
(Contract F19628-67-C-0298)
(AD-673153; AFCRL-68-0311; SR-3; RRA-T87) Avail: CFSTI CSCL 20/6

A Monte Carlo analysis was made of measurements of the scattered light from a searchlight beam. These measurements, reported by Elterman (AFCRL-66-828), were performed to determine the aerosol properties of the atmosphere for altitudes below 35 km. Elterman derived altitude profiles of the aerosol attenuation coefficient from the measured response data by use of single scattering theory for Rayleigh and Aerosol particle scattering. A study was made using the Lite-I Monte Carlo code to investigate the effects of multiple scattering and ozone absorption on the measured response data for 0.55 micrometer wavelength light. Also studied was the effect on the calculated receiver response that results from the use of different aerosol phase functions in the Monte Carlo calculations. The Monte Carlo calculations showed that the effects of multiple scattering and ozone absorption were approximately equal in magnitude, but opposite in effect, thus one can conclude that the neglect of ozone absorption and multiple scattering did not introduce any significant error in Elterman's calculations of the aerosol attenuation coefficient profiles. The major source of error in determining the aerosol attenuation coefficient profile from single scattering theory was found to be in the use of an aerosol phase function that was measured at a different time and geographical location than that used for the searchlight experiment. Author (TAB)

N69-11200# Applied Physics Lab., John Hopkins Univ., Silver Spring, Md.
CERTAIN PROBLEMS OF THE THEORY OF NONLINEAR OSCILLATIONS OF QUASILINEAR SYSTEMS WITH RANDOM LAG
D. G. Korenvskii et al 27 Jun. 1968 31 p refs Transl. into ENGLISH from Mat. Fiz., Akad. Nauk Ukr. SSR (Kiev), v. 3, 1967 p 91–113
(Contract NOw-62-0604)
(AD-675173; APL-CLB-3-7555) Avail: CFSTI CSCL 12/1

The authors consider both single-frequency and multi-frequency random oscillations of weakly linear autonomous systems with many degrees of freedom and stationary random lag, transformed in the limit case to white noise of small spectral intensity. The discussion is based on simultaneous application of the methods of nonlinear mechanics and of the theory of Markov diffusion processes. The results are formulated as specific recommendations. TAB

N69-11286# Argonne National Lab., Ill.
MEASUREMENTS AND TESTS ON MAGNETS FOR THE ZGS FACILITY
Walter F. Praeg 14 May 1968 24 p refs
(TID-24655) Avail: CFSTI

For regulation and ripple studies of dc magnets, the unit step time constant and the 60 Hz and 360 Hz impedance values have been measured for magnets used with the ZGS and in its experimental areas. The measuring circuits are described and the results are summarized. In addition, test methods which detect the presence of shorted turns in magnet assemblies and which find the location of a short between turns of a coil are described. It is suggested that the unit step time constant values be put on the nameplates of the magnets in order that the regulator of each power supply can be set for the correct time constant. Author (NSA)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N69-10028 California Inst. of Tech., Pasadena.
POLARIZATION OF RECOIL PROTONS FROM THE PHOTOPRODUCTION OF NEUTRAL PIONS IN HYDROGEN BETWEEN 750 AND 1450 MeV
Elliott Daniel Bloom (Ph.D. Thesis) 1967 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-17058

In a recent experiment on π^0 photoproduction, the polarization of the recoil proton was measured. The measurement was performed using a scattering and range spark chamber built out of variable thickness carbon modules. The sample of π^0's was pure to better than 98%. Approximately 3500 useful scatters were obtained to yield polarization values, around 60° c.m. for the produced pion, for incoming photon energies $750 \leq k \leq 1450$ MeV. The polarization values were obtained with a maximum likelihood method. A thorough investigation was made of all analyzing power data available for proton carbon scattering. The results indicate a striking angular dependance, with the polarization changing sign for $\theta^*_\pi \approx 60°$ to 70° throughout the energy region covered. These results are interpreted in the framework of an isobar model of π^0 photoproduction with Regge-ized ω exchange amplitude added. Dissert. Abstr.

N69-10029 Stanford Univ., Calif.
FORM FACTORS FROM PCAC AND CURRENT ALGEBRA AND LEPTONIC WEAK INTERACTIONS OF THE HYPERFRAGMENT, LAMBDA HYDROGEN 4
Peter Charles Mc Namee (Ph.D. Thesis) 1967 182 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 67-17460

The form factors for the K_{l5} decay are calculated through the PCAC hypothesis and the SU(3) ⊗ SU(3) algebra of currents. Two methods of calculation are used to obtain the same results: the multiple-soft-pion method, in which all three pions in the final state are taken as zero frequency (non-physical) soft pions, and the single-soft-pion method in which each of the three pions in turn is taken as a soft pion and the subsequent set of simultaneous equations relates the K_{l5} decay amplitude to the K_{l4} decay amplitude. The leptonic decay of the hyperfragment ${}_\Lambda H^4$ is also analyzed. The decay distributions and rates are calculated in impulse approximation for the strangeness changing $0^+ \rightarrow 0^+$ transition ${}_\Lambda H^4 \rightarrow He^4 + l^- + \nu_l$. Numerical results are given assuming Gaussian wave functions for ${}_\Lambda H^4$ and He^4 and taking the single particle transition amplitude $\Lambda \rightarrow p + l^- + \nu_l$ from the Cabibbo hypothesis. Dissert. Abstr.

N69-10030 Cornell Univ., Ithaca, N. Y.
PION-NUCLEON SCATTERING AT HIGH ENERGIES: SPIN DEPENDENCES IN THE FORWARD DIRECTION. 2. REGGE POLES IN THE BACKWARD DIRECTION
Emmanuel Anthony Paschos (Ph.D. Thesis) 1967 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-671

A critical investigation of the interpretation of the data in the Coulomb interference region is undertaken, together with a numerical verification of the Khuri-Kinoshita sum rules. The validity of Regge poles in the scattering of two unequal mass particles in the backward direction is considered. A new Regge representation is introduced involving Legrendre's functions of a modified argument. All of the results are compatible with the results of other investigations. In addition, the pion–nucleon case is discussed including Gribov's theorem on Fermion Regge poles and several other attractive features of formalism. The analysis is done in terms of helicity amplitudes and its generalization to higher spin configurations is straightforward. Dissert. Abstr.

N69-10033 Stanford Univ., Calif.
TECHNIQUE OF HIGH-RESOLUTION, HIGH-ENERGY ELECTRON SCATTERING WITH APPLICATION TO ELASTIC SCATTERING FROM Li^6 AND Li^7
Larry Russell Suelzle (Ph.D. Thesis) 1967 187 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 67-17512

Design and construction of a 100-channel detector system to span the image plane of the Stanford 72-inch, double-focusing, 180-degree magnetic spectrometer is described. The detector and spectrometer are used in electron scattering experiments in conjunction with the Mark III linear electron accelerator. The detector provides resolution in momentum of approximately 0.1% and utilizes the full acceptance in momentum of the spectrometer ($\Delta p/p \approx 9\%$). Results are given for measurements of the nuclear charge form factors for elastic electron scattering from Li^6 and Li^7 at primary beam energies of 100 MeV to 600 MeV. The maximum square of the momentum transferred to the nuclei was 6.9 F^{-2}. Absolute values of the cross sections were obtained by making the comparison to the known absolute proton cross section. For measurements at the primary beam energy of 100 MeV, however, only the ratio of the Li^7 cross section to the Li^6 cross section was measured. The charge form factor for Li^7 could be interpreted in terms of a simple harmonic oscillator shell model with a quadrupole contribution described by the underformed p-shell model. For this model, the rms radius was 2.39 ± 0.03 F, and the electric quadrupole moment required for the fit was in excellent agreement with the spectroscopic measurements. Dissert. Abstr.

N69-10038# Argonne National Lab., Ill.
SOME UNUSUAL PROCESSES IN THE FIELD OF HIGH ENERGY PHYSICS
L. G. Landsberg Jul. 1968 10 p refs Transl. into ENGLISH from Russian Rept. IFVE-SEF-68-1-K
(ANL-TRANS-650) Avail: CFSTI

Several fairly arbitrary assumptions on some new processes which were not previously observed and which are either forbidden or vary strongly suppressed are made. Only such processes for which experimental approaches can be indicated for the verification of the hypothesis made are considered. The mechanism of high momentum transmission, nonleptonic weak processes with high transmitted momenta, the nonpreservation of strangeness, the possible existence of processes with a nonpreservation of baryon charge, other phenomena with large transmitted momenta, and the search for heavy particles in two-body reactions are discussed. NSA

N69-10047 California Univ., Los Angeles.
THEORY OF RADIATIVE TRANSFER IN ATMOSPHERES EXHIBITING POLARIZED RESONANCE FLUORESCENCE
Alain Leon Fymat (Ph.D. Thesis) 1967 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-14259

The theory of radiative transfer in atmospheres illuminated externally and exhibiting polarized resonance fluorescence is presented. The theory is developed for a two-layer atmosphere where one of the layers is composed solely of a homogeneous vertical distribution of fluorescent scatterers and the other layer has an inhomogeneous distribution of both absorbers and scatterers. The albedo for single scattering (i.e., the fraction of absorbed energy which is subsequently re-scattered by a unit volume of the medium) at the fluorescing frequency is assumed to vary exponentially with the total optical depth. The theory introduces new functions and theorems and uses extended forms of functions and theorems employed in existing radiative transfer theories. It takes as a starting point the result that the phase-matrix for resonance fluorescence is separable, i.e., it can be expressed as a finite sum of products of (matricial) functions which depend upon the directions of either the incident or the scattered radiation only. The theory is capable of handling the scattering problem in a medium possessing vertical inhomogeneities. A novel and general method of solving the relevant coupled systems of linear singular integral equations is given. Dissert. Abstr.

N69-10051 Alabama Univ., University.
SOME PARAMETERS OF THE EXCITED STATES OF THE NUCLEI RHODIUM 103, IRON 57 AND THULIUM 169
M. Cherian George (Ph.D. Thesis) 1967 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-1041

For Rh^{103} and Fe^{57}, the measurement and the analysis of the anisotropy coefficients of gamma–gamma anoular correlations of cascade transitions were used to study the spins and parities of the levels. The decay of Yb^{169} to Tm^{169} was investigated by the gamma–gamma coincidence technique as well as by the study of gamma ray singles spectrum. The true anisotropy coefficients in the unperturbed angular correlation between the 555-53 keV and the 440-53 keV gamma ray cascades were measured by using a dilute aqueous solution of enriched Ru^{103}, the parent nucleus. Co^{57} decays into Fe^{57} by orbital electron capture. The directional correlation pattern between the 122-keV and the 14.4-keV gamma rays was studied providing different environments for the decaying iron nucleus by using $CoCl_2$ liquid and solid sources and also a $Co(NO_3)_2$ liquid source. The measured anisotropy coefficients in all these cases were overlapped by the range of experimental errors. The singles spectrum of the gamma rays emitted in the decay of Yb^{169} by orbital electron capture was measured by using a Ge(Li) detector. Coincidence spectra were studied in the case of three gamma-ray cascades. Energy selection was made on the photopeaks of the 93.6-keV, 177.2-keV and the 261-keV gamma rays in three different experiments. Dissert. Abstr.

N69-10058# Maryland Univ., College Park. Dept. of Physics and Astronomy.
INVESTIGATIONS ON THE PROPERTIES OF K MESONS AND HYPERONS AND RELATED TOPICS IN HIGH ENERGY PHYSICS Technical Progress Report, 1 Oct. 1967–30 Sep. 1968
Jul. 1968 41 p refs
(Contract AT(40-1)-2504)
(ORO-2504-127; TR-852) Avail: CFSTI

Research on the fundamental properties of elementary particles and their interactions is reviewed. Kaon interactions are studied primarily. The progress of the experimental bubble chamber and theoretical programs, the spark chamber-counter work, and the PEPR project status are reviewed. NSA

N69-10101 Rensselaer Polytechnic Inst., Troy, N. Y.
MEV NEUTRON TOTAL CROSS SECTIONS OF TANTALUM AND TUNGSTEN ISOTOPES
Richard Charles Martin (Ph.D. Thesis) 1967 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-837

The success of the optical model in describing neutron total cross sections clearly establishes the fact that the general behavior of these cross sections depends strongly on nuclear dimensions, and should therefore be sensitive to nuclear deformations. The effects of deformations on the total cross sections of Ta^{181}, W^{182}, W^{184}, and W^{186} have been investigated first through rough calculations estimating variations arising from quadrupole deformations and second by measurements for these four nuclides and natural tungsten. The calculations were made by considering the effective radii presented to a neutron incident on a deformed nucleus and then applying the usual Optical Model results in a slightly modified form. The results of these estimates suggested that the peaks of the contributions to σ_T from neutrons of different angular momenta should be shifted downward in energy from their spherical values by quadrupole deformations and that these results should be observable in experimental data. Dissert. Abstr.

N69-10118 New Mexico State Univ., University Park.
A CALCULATION OF THE XENON-XENON INTERATOMIC POTENTIAL
Frederick John Jeffers (Ph.D. Thesis) 1967 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-1167

The method of Bleick and Mayer is applied to the calculation of the repulsive part of the xenon-xenon interatomic potential. A general technique and computer programs are developed and used for performing numerically the difficult two electron exchange integrals involved. The wave functions contributing the principle terms in the expression for the repulsive energy are modified by mixing the first excited state in an amount proportional to an undetermined mixing parameter "m." The attractive Van der Waals potential is also modified to include the effects due to the mixing of the excited state. The two atom atomic energy is calculated as a function of m and m is varied so as to minimize the total energy of the two atom system. Dissert. Abstr.

N69-10162# California Univ., Berkeley. Lawrence Radiation Lab.
PHYSICS Semiannaul Report, Nov. 1967–Apr. 1968
David L. Judd May 1968 163 p refs
(Contract W-7405-ENG-48)
(UCRL-18235) Avail: CFSTI

A report on research on theoretical and experimental high-energy physics at the Lawrence Radiation Laboratory is presented. In addition to particle interactions and decays, health physics, computing and data handling, and accelerator operation and development are covered. NSA

N69-10181# Comitato Nazionale Per l'Energia Nucleare, Rome (Italy).
NUMERICAL SIMULATION OF THE GAMMA-DECAY OF A NUCLEUS FROM AN EXCITED STATE
P. Giacobbe, M. Stefanon, and G. Dellacasa 1968 20 p refs
(RT/FI(68)20) Avail: Issuing Activity

This paper describes a numerical simulation of the γ-cascade which follows the resonance capture of a neutron in a medium or heavy nucleus. The calculation has been devised for exploiting the dependence of the γ-cascade on the spin of the capture state [1], [2], and to give information about all the measurable quantities connected with the γ-decay following the capture of neutrons in a given resonance. Author

N69-10232*# Northrop Corp., Hawthorne, Calif. Northrop Corporate Labs.
A STUDY OF CHARGED PARTICLE MOTION IN MAGNETIC RADIATION SHIELDING FIELDS Final Technical Report
S. H. Levine and R. Lepper 1968 72 p refs
(Contract NAS8-21048)
(NASA-CR-98074; NCL-68-28R) Avail: CFSTI CSCL 20H

An experimental method has been effected for determining the angular flux about a point dipole magnet produced by an incident anisotropic charged particle flux. This information will be useful in optimizing active shields with material shields. The experiment was performed with the Magnetic Shield Simulator (MAGSIM), a device used to determine the shape of shielded regions produced by externally deflecting magnets. The MAGSIM was modified to provide more accurate trajectory data for this experiment. Experimental data involved two positions of the electron gun, simulating the incident charged particle flux from two points in space. A computer program has been written to reduce the data and print out the results in a convenient format. The program consists of two parts; the first determines pertinent parameters concerning the trajectories as they score the screen and then punches the data needed as input to the next phase. This first set of calculations is made to assure the accuracy of the data before proceeding to the next part wherein the angular flux is determined. Author

N69-10235# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
A REVIEW OF THE THEORY OF VIBRATIONAL ENERGY TRANSFER BETWEEN SIMPLE MOLECULES IN NONREACTIVE COLLISIONS
D. Rapp and T. Kassal Oct. 1968 213 p refs
(RE-345) Avail: Issuing Activity

The classical, semiclassical, and quantum mechanical procedures used for calculating the vibrational energy transferred in collisions of diatomic molecules are explored in detail. The validities of the approximations used in each method are discussed. Theoretical transition probabilities are calculated and compared for an exponential repulsive interaction between a harmonic oscillator and an incident particle using a linear collision model. Results obtained using potentials which include the effects of anharmonicity and attractive forces are discussed. Treatments of vibrational–vibrational energy transfer in diatomic–diatomic collisions are presented. After introducing thermal averaging procedures and three dimensional calculations, a comparison is made between the theoretical transition probabilities and experimental results. Author

N69-10240 Stevens Inst. of Tech., Hoboken, N. J.
VACUUM FLUCTUATIONS AND SELF-ENERGIES IN MESON THEORY
Lawrence L. Hope (Ph.D. Thesis) 1967 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-1159

The methods and viewpoint developed by Sokolov, Kramers, and Schiller for quantum electrodynamics are applied in meson theory. The spin and isospin of a model nucleon are assumed to interact with an external magnetic field as well as with self and external meson fields. Vector and scalar meson theories, including variational principles, are developed separately. The particle equations of motion incorporate radiation reaction. The magnetic moments of the model nucleon are evaluated by differentiating the particle self energy with respect to the external magnetic field. These magnetic moments are finite. No perturbation expansion in the meson-nucleon coupling constant is used. Dissert. Abstr.

N69-10274*# St. John's Univ., Jamaica, N. Y.
FOUR PHOTON ANNIHILATION OF AN ELECTRON PAIR
Gerard C. Mc Coyd (Ph.D. Thesis) 1965 180 p
(Grant NsG-171)
(NASA-CR-97466) Avail: CFSTI CSCL 20H

The reduced cross section for four photon annihilation of an electron positron pair is calculated for arbitrary energy. It is integrated for the special case in the nonrelativistic limit in which two of the photons are soft and one hard photon is emitted in a small cone centered on the direction of the incident positron. This result is used to estimate the total cross section for in-flight annihilation in the nonrelativistic limit, and the lifetime of positronium for four photon decay from the $1\,^1S_0$ state. The concept of the reduced cross section affords a considerable economy in computational labor. Author

N69-10282 Ohio Univ., Athens.
NEGATIVE PION-PROTON INTERACTIONS AT 4.65 GeV/c
Ahmed Lotfy Elattar (Ph.D. Thesis) 1967 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-1953

Negative pion-proton interactions at 4.65 BeV/c resulting in two charged secondaries are studied for elastic scattering and single pion production. The dynamics of these interactions are studied to check the validity of existing theoretical models. Interactions of negative pions at 4.65 GeV/c from an alternating gradient synchrotron with protons in the BNL 20 bubble chamber were photographed. The film was scanned and measured using conventional digitizers. 3500 two-prong events were analyzed using geometrical reconstruction program TRED and kinematical fitting program GUTS. The events were classified into elastic collisions, single pion production or multi-pion production according to the visual identification of the outgoing positive tracks. Elastic scattering results were compared with optical model and Regge Pole theorem predictions. Single pion production events were investigated for mesonic and haryonic resonances using both energy plot and four momentum transfer techniques. The overall c.m. distributions were also plotted. Interaction mechanisms were studies in the light of the One Pion Exchange (OPE) and the Absorptive OPE models. Dissert. Abstr.

N69-10317# Comitato Nazionale Per l'Energia Nucleare, Frascati (Italy).
HIGH ENERGY EXPERIMENTS ON QED
C. Bernardini 8 Jul. 1968 25 p refs
(LNF-68/42) Avail: CFSTI

Recent efforts to test QED in the high energy region are reviewed, and the kinematics of two-body reactions are summarized. The complete collection of first order electromagnetic processes is tabulated, as are the simple possibilities in high energy QED. For the latter processes, the equivalent contaminated process, main contamination channel, observation technique, and existence of space-like and time-like leptons and photons are included where applicable. It is concluded that electron data at the space-like virtual momenta appear to be good up to ≈ 700 MeV for virtual photons, ≈ 500 MeV for virtual electrons; ≈ 800 MeV for muons. For

time-like momenta, the data are poorer or limited to lower values. Storage rings are considered promising, but time-like virtual leptons "will remain in the dark for some time." M.W.R.

N69-10337 Denver Univ., Colo.
VIBRATIONAL EXCITATION EFFECTS UPON CHARGE TRANSFER CROSS SECTION MEASUREMENTS FOR THE PROCESSES MOLECULAR HYDROGEN ION IN HYDROGEN, DEUTERIUM AND ARGON AND FOR MOLECULAR DEUTERIUM ION IN HYDROGEN
Howard Corwin Hayden, Jr. (Ph.D. Thesis) 1967 81 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-2398

Charge transfer cross sections have been measured, and ion beam excitation effects investigated for H_2^+ ions in H_2, D_2 and Ar gases, and for D_2^+ in H_2. The ion energy range was 250 to 1000 eV except for the H_2^+ in H_2 which was studied from 70 to 1000 eV. Electron energies in the electron impact ion source were varied from 16.0 eV to about 21 eV. Measured cross sections for H_2^+ in Ar at 700 eV continued to increase as the electron energy was decreased. The overall change was about 20%. This reaction showed that relative populations of excited states were changing in the electron energy range where H_2^+ in H_2 cross sections were constant. Evidently, the lower vibrational levels of H_2^+ all have about the same cross section for charge transfer in H_2. Dissert. Abstr.

N69-10338 Cornell Univ., Ithaca, N. Y.
NUCLEAR CORRECTIONS TO ATOMIC ENERGY LEVELS: AN EFFECTIVE POTENTIAL APPROACH
Howard Grotch (Ph.D. Thesis) 1967 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 67-17236

There has been a discrepancy of 45 ppm between the experimental measurement and the theoretical prediction of the hyperfine splitting (hfs) of the ground state of atomic hydrogen. Such a disagreement could conceivably be explained by a breakdown of quantum electrodynamics, a modification of the fine structure constant, or an incorrect estimation of the nuclear corrections to the hfs. The last of these alternatives provided the motivation for this thesis and it receives the most attention. Most of the calculations of nuclear corrections to atomic binding in hydrogen have been done with the help of the covariant Bethe-Salpeter (BS) equation. Although the BS approach provides a complete treatment of the problem, its complexity makes it desirable to find an alternative formalism. In this work an effective potential approach, within the context of the Dirac equation, is presented. Dissert. Abstr.

N69-10339 California Univ., Berkeley.
A MEASUREMENT OF THE DIFFERENTIAL CROSS SECTIONS FOR CHARGE EXCHANGE AND RADIATIVE CAPTURE OF NEGATIVE PIONS IN HYDROGEN AT 50 MeV LABORATORY ENERGY
Jim Byars Carroll (Ph.D. Thesis) 1967 82 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-42

The differential cross sections of $\pi^- + p \rightarrow \gamma + n$ and $\pi^- + p \rightarrow \pi^0 + n(\rightarrow \gamma + \gamma + n)$ have been measured at an incident pion laboratory-system kinetic energy of 54 MeV. The reactions were identified by detecting and measuring the energy of a final-state photon with a large total absorption counter placed at a laboratory-system angle of 84 deg. Using the principle of detailed balance, and our measurement of the cross section for the first reaction, we have calculated the isotropic term in the cross section for the reaction $\gamma + n \rightarrow \pi^- + p$, obtaining $a^-_0 = 16.4 \pm 3.2$ μb/sr at $p^*_\gamma = 170$ MeV/c. This value is in reasonable agreement with other data obtained from photoproduction in deuterium. Dissert. Abstr.

N69-10342# Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Lab. Nazionali di Frascati.
THE STUDY OF K° MESON DECAYS BY COLLIDING BEAMS
G. K. O'Neill (Princeton Univ.) 15 Jul. 1968 5 p ref /its Internal Note No. 410
(LNF-68/43) Avail: CFSTI

The application of electron-positron storage rings to experiments dealing with the branching ratios and lifetime of the long-lived neutral K-meson is noted, as is the possibility of performing unusually clean experiments on the CP-violation parameters by colliding beams. The simple experimental conditions and the freedom from background which characterize events made by e+e- annihilation with a four-prong signature are noted in terms of neutral K-meson experiments. M.W.R.

N69-10344# Rensselaer Polytechnic Inst., Troy, N. Y. Nuclear Engineering and Science Div.
NEUTRON RADIATIVE CAPTURE IN Na, Al, Fe, AND Ni FROM 1 TO 200 KEV
R. W. Hockenbury, Z. M. Bartolome, J. R. Tatarczuk, W. R. Moyer, and R. C. Block [1968] 82 p refs
(Contract AT(30-3)-328)
(TID-24601) Avail: CFSTI

Neutron radiative capture in Na, Al, Fe, and Ni was measured from 100 eV to 200 keV with a 1.25-meter diameter liquid scintillator detector. Radiative widths were determined from those resonances where the neutron widths are well known, while the resonance capture areas ($\sigma_0\Gamma_\gamma$) were determined for most of the other resonances. Considerably more resonances were observed in the capture measurements upon Fe and Ni than had been observed in total cross section measurements. It is reasonable to assign most if not all these previously undetected resonances to p-wave neutrons; and from these data p-wave strength functions of $0.10 \pm 0.04 \times 10^{-4}$ and $0.04 \pm 0.03 \times 10^{-4}$ were determined, respectively, for ^{56}Fe and ^{58}Ni. These strength functions are probably an upper limit to the true p-wave strength functions and are an order of magnitude smaller than optical model predictions. Author (NSA)

N69-10380 Oregon State Univ., Corvallis.
THE DECAY OF 4.1 HOUR Zn-71 AND THE LEVELS OF Ga-71 BY THE UNIFIED MODEL: LEVELS OF Zn-70 BY THE Zn-70(ALPHA ALPHA PRIME) REACTION
Larry Russell Cooper (Ph.D. Thesis) 1968 147 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-17578

Precision spectroscopy experiments were carried out on the gamma radiations emitted in the decay of 4.1 hour Zn^{71} and several new transitions were identified. From these results, a decay scheme is proposed for Zn^{71} in which most of the ambiguities in previously reported schemes have been removed. Using the intermediate coupling Unified Model of the nucleus, the level energies of Ga^{71} have been calculated. Vibrational phonon states of the core nucleus of Zn^{70} are coupled to proton single particle states $2p_{3/2}$, $1f_{5/2}$, $2p_{1/2}$, and $1g_{9/2}$ through a perturbing interaction. For the calculation of radial integrals, radial wave functions are either those generated by a Harmonic Oscillator potential or by a Saxon-Woods potential. Energies and spins of the core excited states were determined by observing the scattering of 42 Mev alpha particles from Zn^{70} and analyzing the inelastic scattering cross sections using the diffraction model. Dissert. Abstr.

N69-10381 Washington Univ., St. Louis, Mo.
He-3 ALPHA REACTIONS ON INTERMEDIATE MASS NUCLEI
David Dee Borlin (Ph.D. Thesis) 1967 205 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 67-17177

In order to investigate the utility of the $(^3H,\alpha)$ reaction as a spectroscopic tool in nuclear structure research, targets of ^{40}Ca, $^{46,48,50}Ti$, ^{54}Fe, and $^{64,66,68,70}Zn$ have been bombarded with a 33 MeV ^3He beam. The shapes of the resulting angular distributions were used to assign l values to some of the observed levels. Indications of a J-dependent effect were observed for transitions involving a transfer of $l=1$ or $l=3$. Transitions involving $l=3$ or 4 were found to be greatly enhanced over those involving lower l values, in direct contrast to other neutron-pickup reactions which enhance the lower l values. The large positive Q value of the $(^3He,\alpha)$ reaction permitted the investigation of regions of high excitation energy in the residual nuclei and the resulting observation of a number of isobaric-analog states. Dissert. Abstr.

N69-10438# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
ABSORPTION OF GAMMA-RAYS IN SILICON AND CALCIUM
N. Bezic, D. Jamnik, G. Kernel, J. Krajnik, and J. Snajder May 1968 8 p refs Submitted for publication
(NIJS-R-532) Avail: Issuing Activity

Results of total absorption measurements of gamma rays in the giant resonance region for silicon and calcium are given and compared with existing data on photonuclear reaction cross sections. Author

N69-10476# Groningen Rijksuniversiteit (Netherlands).
SPUTTERING AND ELECTRON EMISSION EXPERIMENTS WITH AN ELECTROMAGNETIC ISOTOPE SEPARATOR
Sietze Anne Drentje 1968 114 p refs
(NP-17564) Avail: Issuing Activity

The Groningen electromagnetic isotope separator and ion source are described, and a survey of the work with this separator is given. In the experiments, oriented Au foils, bombarded by 50 keV noble gas ions, show sputtering maxima in the ⟨110⟩ directions. Sputtering from a (100) Cu face by 30 to 80 keV argon ions at various incident angles shows minima in the open directions of the crystal. Similarly, the electron emission of a bombarded (100) Cu face shows minima in the open directions. The theoretical interpretation of the results is considered and a shadow model for sputtering and electron emission is developed. Focused collision sequences (focusons) are considered. NSA

N69-10477# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
DIFFERENTIATION BETWEEN Ho 1 AND Ho 2 SPECTRA USING ONLY A DC ARC AS EXCITATION SOURCE
S. Held May 1968 65 p refs
(IA-1162) Avail: Issuing Activity

Differentiation between the neutral and ion spectra of Ho in the 2260 to 5454 Å spectral range was achieved using only a dc arc as excitation source. The spectrum assignments are supported by differences in the line intensities of the Ho spectra obtained in electrodeless discharge and spark excitation. The wavelengths were taken from Gatterer and Junkes. Author (NSA)

N69-10515# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France). Faculte des Sciences.
REGGE POLES AND POLARIZATION IN KAON p ELASTIC SCATTERING
Guy Plaut Sep. 1968 16 p refs
(Rept.-68/30) Avail: Issuing Activity

A five Regge pole is presented and used to fit polarization data in K⁻p elastic scattering between 2 and 2.4 GeV/c. Following a phenomenological analysis, we obtain solutions consistent with high energy data and we give sample predictions for polarization in other KN scattering experiments. Author

N69-10516# Tokyo Univ. (Japan). Inst. of Physics.
TWO-LEVEL FORMULA FOR EXTREMELY OVERLAPPING RESONANCES AND ITS APPLICATION TO THE A_2
Yasunori Fujii and Masaaki Kato Oct. 1968 59 p refs
Avail: CFSTI

A two-level formula for overlapping and inelastic resonances is examined, confining most of the considerations to the extreme case where the elastic S-matrix element has two poles and two zeros sharing the same real part. By this simplification many unusually looking behaviors of the cross sections characteristic to extremely overlapping resonances are given simple algebraic formulas, without using numerical calculations. A peculiar phenomenon, a dip in the inelasticity factor associated with two peaks in the total and elastic cross sections, is naturally explained. The formalism is applied to the double-peaked structure of the A_2. A preliminary analysis shows that the data can be fitted by two resonances, referred to as the $A_2{}^B$ and $A_2{}^N$, which are assumed to have the same spin and parity, and the almost common mass $\approx$ 1300 MeV, while with the different widths $\approx$ 70 MeV and $\approx$ 18 MeV, respectively. Author

N69-10520# Illinois Univ., Urbana. Dept. of Physics.
ELASTIC SCATTERING OF He-3 FROM C-12 FROM 18 TO 24 MeV
S. I. Warshaw, A. J. Buffa, J. B. Barengoltz, and M. K. Brussel 19 Aug. 1968 38 p refs
(Contract N00014-67-A-0305)
(AD-673541) Avail: CFSTI CSCL 20/8

Angular distributions of Helium-3 nuclei elastically scattered from Carbon-12 were taken at Helium-3 beam energies of 18.6, 20.0, 22.2, and 23.9 MeV and analyzed with six-parameter local optical model potentials having volume and surface absorption terms. It was found not possible to obtain good predictions to the data over the full angular range examined, but sets of optical modal parameters which gave good fits to the data below 85 deg. (c.m.) were obtained. These sets had real well depths clustering around mean values of 75, 130, and 210 MeV. No substantial distinction seemed evident in the quality of the fits between the volume and surface absorption analyses, but perhaps more consistent sets of real well depths were obtained for the surface case. The quality of the fits appeared to improve with higher bombarding energy. Author (TAB)

N69-10529# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
ATOMIC AND MOLECULAR SCATTERING FROM SOLIDS: I-PLANAR SCATTERING FROM ONE-DIMENSIONAL SURFACE ARRAYS (AN EXTENDED DATA SET)
J. Doyle Mc Clure and Yau Wu (Va. Polytechnic Inst.) Oct. 1968 90 p refs Submitted for publication
(Di-82-0732) Avail: Issuing Activity

Results of a comprehensive study of a 2D scattering system are presented. In its most general form, the model corresponds to a uniform stream of atoms which approaches the surface with prescribed velocity distribution and angle of incidence and interacts with elements representing the surface of an elastic, finite temperature solid. The 2D surface field is constructed from superposed Lennard-Jones 6-12 pairwise potentials. This study represents the first adequate statistical treatment of gas surface scattering on the basis of multidimensional, finite range interaction. Individual microstate trajectories, which are governed by Newtonian mechanics, are determined by numerical integration of the trajectory equations on a high speed digital computer. Final state properties determined from these single trajectory calculations provide means for isolating characteristic scattering behavior as affected by individual variation of the many defining parameters. Author

N69-10569# Pittsburgh Univ., Pa. Dept. of Physics.
THEORY OF GAMMA-RAY CROSS SECTIONS
R. H. Pratt Nov. 1967 18 p refs Presented at the Am. Nucl. Soc., 5–9 Nov. 1967
(Contract AT(30-1)-3829)
(NYO-3829-17) Avail: CFSTI

Theory of the interaction between gamma rays and isolated atoms is reviewed, indicating recent progress and discussing future prospects. The photoelectric effect, scattering, and pair production are discussed in detail. 26 references. NSA

N69-10579# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
EXACTLY SOLUBLE MODEL FOR RESONANCE SCATTERING
I. Lovash and Ya. Revai 1968 22 p refs
(JINR-E4-3837) Avail: CFSTI

A model system is constructed consisting of a single particle potential and two interacting particles. The potential has two bound states thus for the two particle system four configurations exist. One of them lies in the continuum giving rise to a resonance of compound type. Both the potential and the two particle interaction are of nonlocal and separable types. The exact transition amplitudes are obtained by Faddeev's method. The model is designed for checking the microscopic nuclear reaction theories. Author (NSA)

N69-10588# Rochester Univ., N. Y. Physics and Astronomy Dept.
OBSERVATION OF MULTIPION RESONANCES AT 1630 AND 1720 MEV IN HIGH-ENERGY PION p COLLISIONS
C. Baltay (Columbia Univ., N. Y.), H. Kung (Columbia Univ., N. Y.), N. Yeh (Columbia Univ., N. Y.), T. Ferbel, P. F. Slattery et al Aug. 1968 13 p
(Contract AT(30-1)-875)
(CONF-680809-13; UR-875-248) Avail: CFSTI

The results of a hydrogen bubble chamber investigation of multipion production in $\pi^+ + p$ interactions at momenta of 6.95 and 8.5 GeV/c are presented. These data provide strong support for the existence of two isospin-1 resonances, a negative G-parity state at 1630 ± 10 MeV having a width of 70 ± 40 MeV and a positive G-parity state at 1720 ± 15 MeV having a width of 100 ± 35 MeV. These resonances are produced peripherally with observed production cross sections of approximately 40 and 60 μb, respectively. The results are based on an analysis of 6959 events of the reaction $\pi^+ + p \rightarrow p + 2\pi^+ + \pi^-$ and 5744 events of the reaction $\pi^+ + p \rightarrow p + 2\pi^+ + \pi^- + \pi^0$. NSA

N69-10589# Academy of Sciences (USSR), Moscow. Physics Inst.
PARTICLE MOTION IN HELICAL FIELDS WITH EQUIPOTENTIAL COINCIDING MAGNETIC SURFACES
A. P. Popryadukhin 1968 21 p refs In RUSSIAN *Its* Preprint
(NP-17586) Avail: CFSTI

Electrical field effects on the motion of particles in a system of helical symmetry were studied. The data show that even small electric fields exert an effect which results in strong redistribution of particle velocities according to various types of motion. Detailed studies of particle motions in complex configurations of electric fields are reported. NSA

N69-10590# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
THE THEORY OF ONE-DIMENSIONAL LATTICE IN PSEUDOHARMONIC APPROXIMATION [TEORIYA ODNOMERNOI RESHETKI V PSEVDOGARMONICHESKOM PRIBLIZHENII]
N. M. Plakida and T. Siklos 1968 26 p refs In RUSSIAN; ENGLISH summary
(JINR-P4-3706) Avail: CFSTI

The properties of a linear chain are considered in the pseudoharmonic approximation at fixed length or fixed external tension. It is shown that the chain is unstable in the second case at sufficiently high temperature or sufficiently high zero-point energy. An internal energy, heat capacity, and coefficient of thermal expansion are calculated. Author (NSA)

N69-10593# Joint Inst. for Nuclear Research, Dubna (USSR).
PRELIMINARY CALCULATIONS OF THE GROUND STATE CHARACTERISTICS OF THE He-4 NUCLEUS
J. Blank and I. Ulehla 1968 22 p refs
(JINR-E4-3927) Avail: CFSTI

Some results of the calculation of the binding energy, mean-square radius, charge distribution, and form factor of the ^{4}He nucleus are presented. The Goldstone perturbation theory is applied up to the second order in the energy and first order in the wave function. The Hamada–Johnston potential is used. Author (NSA)

N69-10595# Montpellier Univ. (France). Department de Physique Mathematique.
AN ANALYSIS OF THE $\rho, \omega, \phi \rightarrow 2\pi + \gamma$ DECAYS WITH THE HELP OF CURRENT ALGEBRA
F. M. Renard Oct. 1968 34 p refs
(PM/68/4) Avail: CFSTI

The decay modes $\rho, \omega, \phi \rightarrow 2\pi + \gamma$ are studied in a gauge invariant way with current algebra, the hard pion and Ward identities technique, and meson dominance. A comparison with the π, A_1, ρ and σ pology is done; the ω, ϕ, H, f_0, A_2 terms for the ρ decays, and the ρ, B, f_0 terms for the ω, ϕ decays are added as supplementary contact terms. The angular distributions, photon spectra, and decay rate are discussed in terms of coupling constants (essentially $g_{\rho\pi\pi}$, $g_{\phi\rho\pi}$, $g_{\rho\pi\gamma}$) and of the σ-terms parameters (mass and couplings). Author

N69-10602# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
THE ALPHA DECAY OF CF-245
W. Kusch and Z. Szeglowski 1968 11 p refs
(JINR-E6-3992) Avail: CFSTI

The α spectrum of the isotope ^{245}Cf was investigated using a surface-barrier semiconductor detector. Besides the main α group, four groups with low intensities were observed. An attempt was made to compare the α energy with those of rotational bands built on the Nilsson states, which are known in this region of neutron numbers. Author (NSA)

N69-10607# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
GROUP ANALYSIS OF SCATTERING AMPLITUDES. THE GROUP SU (1,1)
A. P. Balachandran (Syracuse Univ., N. Y.) and J. Nuyts Sep. 1968 12 p refs Sponsored in part by AEC
(TH/68/33) Avail: CFSTI

An expansion for scattering amplitudes involving four particles of equal mass is proposed. It displays the dependence of the amplitude on all the Mandelstam variables and is intimately related to the Koténski expansion in terms of transversality amplitudes. Author

N69-10619# Argonne National Lab., Ill.
PHOTOPRODUCTION OF THE W-MESON PAIRS
V. G. Kompaneets Jul. 1968 9 p refs Transl. into ENGLISH from Inst. of High Energy Phys. (Serpukhov), Rept. IFVE-STF-67-66-K
(ANL-TRANS-649) Avail: CFSTI

The analytical expression of the cross section for the W-meson pair photoproduction is obtained. The cross section is given in the form of the double integral in the invariant variables. The analysis of the threshold and asymptotic behaviors of the cross section is given. The numeral computation of the cross section is made for the masses 2, 2.5, and 3 GeV. Author (NSA)

N69-10621# Oak Ridge National Lab., Tenn.
SCATTERING OF THERMAL ELECTRONS BY POLAR MOLECULES
A. A. Christodoulides (M.S. Thesis—Tenn. Univ.) and L. G. Christophorou Aug. 1968 69 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2257) Avail: CFSTI

Mean scattering cross sections and drift velocity data for thermal electrons in thirty-one polar molecules in the pure form and four in mixtures with ethylene have been obtained and are discussed. The electric molecular dipole moment, μ, ranges from 0 to ≈4.1 Debye units (D.u.). From an analysis of the experimental data the general conclusion is drawn that the point dipole Born approximation calculation of Altshuler (1957) is in better agreement with experiment than the exact calculation of Mittleman and von Holdt (1965). Further, the experimental cross sections are higher than those predicted by Altshuler for all $\mu \leq 2.4$ D.u. and smaller when $\mu \geq 2.4$ D.u., while their behavior at and around the minimum dipole movement, μ_{min}, required to bind an electron is complicated. The overall dependence of the experimental cross sections on μ indicates the possible effect of the binding of an electron to a molecule (when $\mu > \mu_{min}$) and is consistent with the existence of a potential resonance as predicted by Takayanagi and Itikawa (1968). Author (NSA)

N69-10628# European Atomic Energy Community, Geel (Belgium). Joint Nuclear Research Center.
A SIMPLIFIED METHOD FOR KINEMATIC CALCULATIONS OF NUCLEAR REACTIONS
J. Winter and H. Schmid Brussels 1968 17 p refs
(EUR-3908.e) Avail: CFSTI

A simplified method of presentation of kinematic relationships in nuclear reactions is given. It allows to obtain in a convenient way the energy of the reaction products as a function of the angle of emission in the laboratory frame for non-relativistic reactions. It has been shown that after the introduction of normalized quantities the kinematics of all non-relativistic reactions may be calculated by means of only one equation. To facilitate handling, this equation has been tabulated. In the single valued region ($0 \leq \eta \leq 1$) the incremental step of the parameter η is 0.01 and the angle Θ increases in steps of 5 deg. from 0 to 180 deg. In the double valued region ($\eta > 1$) tabulation of η is given only up to $\eta = 2$, the incremental steps being 0.02 and 5 deg. Author

N69-10630# Tokyo Univ. of Education (Japan). Dept. of Physics
CONSERVATION OF THE NUMBER OF FERMIONS
Y. Ohnuki (Nagoya Univ., Japan) and S. Kamefuchi 1968 7 p refs
(TUEP-68-22) Avail: CFSTI

Some kinds of composite particles consisting of paraparticles do not obey the ordinary parastatistics. It is proposed to call such particles quasi-parabosons or quasi-parafermions according to whether a certain physical quantity, to be called A, takes even or odd values for these particles. It is argued that the total number of fermions, parafermions and quasi-parafermions is absolutely conserved modulo 2 in all reactions. The theoretical importance of the parallelism which exists between the quantity A and angular momentum is emphesized in connection with the spin-statistics theorem. Author

N69-10643# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
DIRECTIONAL CORRELATIONS OF GAMMA CASCADES IN Dy-160.
A. Z. Hrynkiewicz, J. Styczen, Z. Szeglowski, and W. Walus 1968 10 p refs
(JINR-E6-3905) Avail: CFSTI

Directional correlation measurements were performed for the following gamma cascades in ^{160}Dy: 1178 KeV–87 keV, 1272 keV–87 keV, 1003 keV–197 KeV, 1115 keV–197 keV, 299 keV–879 keV, and 299 keV–966 keV. Obtained results corroborate the spin assignments $I = 2$ for the 1264 and 1358 keV states and $I = 3$ for the 1286 keV state. For the 1386 keV state, $I = 4$ was established. The existence of the 872 keV transition was confirmed and its absolute gamma intensity was determined as 0.24(6)%. Author (NSA)

N69-10647# Polish Academy of Sciences, Warsaw.
LABORATORY ELECTRON GUN: 50 kV. THE CONSTRUCTION OF THE GUN AND MEASUREMENTS OF PARAMETERS OF ELECTRON BEAM [LABORATORYJNE DZIALO ELEKTRONOWE: 50 kV. KONSTRUKCJA DZIALA I POMIARY PARAMETROW WIAZKI ELEKTRONOWEJ]
Lech Jakubowski and Elzbieta Sadowska 1968 31 p refs In POLISH; ENGLISH summary
(INR-P-893/XVIII/PP) Avail: Issuing Activity

A detailed description is presented of the construction of a laboratory electron gun which ensures a beam current about 15 mA with an extraction voltage of 50 kV and with a magnetic focusing. The most advantageous parameters and operational characteristics of the gun are established. By means of static and dynamic methods the shape and convergence of the electron beam as well as current density distributions over the beam cross-section were investigated. Determined on the basis of those measurements the minimum cross-over was equal 0.1 mm at the beam current 100/uA. For the greater currents (up to some mA at the voltage 15 kV) the average current density amounted to 25 mA/mm^2 in the cross-over of diameter about 0.5 mm. Author (NSA)

N69-10654# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
A COMPUTER CODE FOR CALCULATION OF TRANSPORT PROPERTIES OF HIGH TEMPERATURE GASES
W. S. Rigdon Jul. 1968 150 p refs
(DAC-59134) Avail: Issuing Activity

This report describes the theory, operating instructions, and logic for computer programs F984-Phase I, and F984-Phase II. These programs compute the transport properties of an equilibrium gas mixture. The programs are written in FORTRAN IV interpretive language. Deck set-up procedures are provided for operation of the programs on the UNIVAC 1108 computer; however, only minor modifications are required to adapt the programs to other computers. The capabilities of each program are described in detail. The logic analyses include flow diagrams, complete listings, and glossaries of program symbols. Sample calculations are presented illustrating different program capabilities. The results of the sample calculations are compared with previously published theoretical and experimental values. Author

N69-10657# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
CONCERNING $\xi \rightarrow \Lambda \pi \gamma$ DECAYS
V. I. Zakharov 1967 18 p refs In RUSSIAN; ENGLISH summary
(ITEF-560) Avail: Issuing Activity

It is shown that amplitudes of $\xi \rightarrow \Sigma \pi$ transitions may be determined through measurement of the probability of hard

photon emission and the magnitude of correlation between hyperon polarization and photon momentum in decays $\xi \rightarrow \Lambda\pi\gamma$. Determination of these amplitudes is of interest from the point of view of checking SU(3) symmetry which allows one to express matrix elements of these transitions in terms of observable nonleptonic decay amplitudes. Partial widths which are to be measured are of order 10^{-3}–10^{-5} of the full width ξ hyperon.
Author (NSA)

N69-10694# Joint Inst. for Nuclear Research, Dubna (USSR).
NEUTRON PROTON INELASTIC INTERACTIONS AT ENERGIES FROM 2 TO 10 GEV. 3: STUDY OF N PION PION COMBINATIONS IN THE REACTION: NEUTRON PROTON YIELDS NEUTRON PROTON POSITIVE PION POSITIVE PION NEGATIVE PION NEGATIVE PION (m NEUTRAL PION)
V. I. Moroz, A. V. Nikitin, and Yu. A. Troyan 1968 9 p refs
(JINR-E1-3940) Avail: CFSTI

There were 730 events of the type $np \rightarrow np\pi^+\pi^+\pi^-\pi^-(m\pi^0)$ originating in a propane bubble chamber in an exposure to neutrons with energies from 2 to 10 GeV selected. It is seen that the effective mass distributions of $p\pi^+\pi^+$, $p\pi^+\pi^-$ and $p\pi^-\pi^-$ combinations are satisfactorily explained by $N^{*++}_{(1238)}$ and $N^{*-}_{(1286)}$ productions.
Author (NSA)

N69-10700# Sandia Corp., Albuquerque, N. Mex.
EFFECT OF PRESSURE ON SPIN-ORBIT COUPLING AND THE FERMI SURFACE OF CD
J. E. Schirber and W. J. O'Sullivan Aug. 1968 4 p refs Presented at the Conf. on Low Temp. Phys., St. Andrews, Scotland
(Contract AT(29-1)-789)
(SC-DC-68-2295; CONF-680808-3) Avail: CFSTI

The effects of hydrostatic pressure on several features of the Cd Fermi surface were studied for applied magnetic field directions along or near [0001]. Measured pressure derivatives are presented for the α,β, and γ cross sections of the Fermi surface; the measurements were made using the de Haas-van Alphen phase-shift technique at 1 to 4°K. The results are compared with those expected from the analogy with Zn and nearly free electron considerations.
NSA

N69-10719# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.
INTERACTION OF HEAVY keV IONS WITH GASES Progress Report, 1 Jun. 1967–31 May 1968
John W. Boring Jun. 1968 15 p refs
(Contract AT(40-1)-2911)
(ORO-2911-10; EE-3930-105-68U) Avail: CFSTI

The experimental work was concerned with continuing the development of a method of measuring total ionization by heavy ions in gases, and with the initial measurements of differential cross sections for the scattering of ions in the keV energy range. The ionization studies were directed toward an investigation of gas mixtures in an effort to learn more about the ultimate distribution of the primary ion's energy, and the first cross section measurements were concentrated on the elastic scattering of light ions by argon atoms to investigate the interaction potential between the collision partners. Theoretical work is also described.
NSA

N69-10721# New Mexico Highlands Univ., Las Vegas. Dept. of Chemistry.
RADIATIVE-NEUTRON-CAPTURE REACTIONS IN ORTHOPHOSPHATES: THE CATION EFFECT
Vincent C. Anselmo and Theodore Rekart 2 Aug. 1968 4 p
(Contract AT(11-1)-1618)
(COO-1618-8) Avail: CFSTI

Data were collected on several different oxidation states formed in radiative neutron capture reactions in orthophosphates. For mono-alkali metal orthophosphates, there was a reduction as hypophosphite and orthophosphite, with an increase in the fraction as orthophosphate as the atomic weight of the cation increased. For di-alkali metal orthophosphates there appeared to be no dependence on cation. There was also a large increase in the fraction as orthophosphite.
NSA

N69-10723 Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.
FLUX FLOW VELOCITIES BY TIME-OF-FLIGHT METHOD
Hans Meissner [1968] 4 p refs Supported in part by NSF
Avail: Issuing Activity

In the experimental arrangement described, a constant density current is passed through a thin tin film, vapor-deposited on the front of a 2.5 × 2.5 coverglass. A similar silver film or brass foil in the back serves as the current return. A bundle of flux tubes is pulsed in at the left side of the sample by passing a current pulse of 1.5 μsec duration through a small Helmholtz coil. The current in the superconducting tin film moves the flux bundle to the right, where it is sensed with pick-up coils near the right edge of the film. Reversal of the current (or flux) reverses the direction of motion.
Author

N69-10738# California Univ., Livermore. Lawrence Radiation Lab.
MAFCO2: A CODE FOR CALCULATING A GUIDED CENTER TRAJECTORY OF A PARTICLE IN MAGNETIC AND ELECTRIC FIELDS
W. A. Perkins and D. Fuss 28 May 1968 27 p refs
(UCRL-50438) Avail: CFSTI

MAFCO 2 is written in FORTRAN language and can be used on any computer which can compile a machine language code from a FORTRAN deck and has a memory greater than 50,000 words. The purpose of the code is to allow one to follow the guiding-center trajectory of a particle in a magnetic field generated by rather general current elements. The magnetic field is calculated in the same manner as in MAFCO, with the addition that it can change with time. One can introduce electric fields which are constant over designated regions of space and others which are created by point charges. The current-carrying conductors must be approximated by straight lines, circular loops, arcs of circles, or series of points designating the geometry of a general current element. For the guiding center approximation to be valid, the particle motion must be adiabatic.
Author (NSA)

N69-10739# Gosudarstvennyi Komitet po Ispolzovaniyu Atomni Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
COEFFICIENTS OF ANGULAR CORRELATIONS OF DIPOLE γ TRANSITIONS OF NUCLEI
G. A. Lobov 1967 12 p refs In RUSSIAN; ENGLISH summary
(ITEF-564) Avail. Issuing Activity

Simple analytical expressions for the coefficients of various angular correlations in case of dipole and quadrupole γ transitions in nuclei, with arbitrary spins of nuclear states, are derived. Some properties of the Clebsch–Gordan, Fano and Racah coefficients are used. With the analytical expressions obtained for the coefficients, one can calculate angular correlations in a more simple way; and there is no necessity to use numerical tables for these coefficients.
Author (NSA)

N69-10762# Argonne National Lab., Ill.
TIME AND ENERGY DISTRIBUTION CHARACTERISTICS OF NEUTRONS EMITTED FROM HYDROGEN-CONTAINING RADIATORS. NEUTRON ABSORPTION TIME DISTRIBUTION IN A STRONGLY ABSORBING MEDIUM

D. L. Broder et al Jun. 1968 9 p ref Transl. into ENGLISH from Russian Rept. FEI-85, 1967
(ANL-TRANS-638) Avail: CFSTI

The time and energy distributions of neutrons which depart from hydrogen-containing moderating radiators are considered. Results are discussed which have been obtained by the Monte Carlo method for a neutron source with a Maxwellian spectrum at various thickness of moderating radiators. Results from the calculation of the time distribution of the absorption of neutrons of different energies in plates consisting of a mixture of boron and hydrogen are discussed. Author (NSA)

N69-10767# Hamburg Univ. (West Germany). Experimental Physics Inst.
ANALYSIS OF SINGLE NEGATIVE PION AND POSITIVE PION PHOTOPRODUCTION ON DEUTERIUM AT HIGH ENERGIES AND LOW MOMENTUM TRANSFERS
K. Schilling Jun. 1968 14 p refs
(DESY-68/35) Avail: CFSTI

Using the impulse approximation and accounting for the complete spin—isospin structure of the deuteron, it is shown that the photoproduction of single charged pions in the deuteron is suppressed by a factor of about 1–1/3 S(q) (S,q denote the deuteron form factor and the momentum transfer to the pion) with respect to the photoproduction on the free nucleon. For π^+ photoproduction the Glauber correction is estimated to be less than 12 per cent. Author (NSA)

N69-10769# Groningen Rijksuniversiteit (Netherlands).
SCATTERING OF POLARIZED D-D NEUTRONS IN A DIFFUSION CLOUD CHAMBER
Jan Pieter Fokke Mulder (Ph.D. Thesis) 1968 151 p refs Supported in part by Neth. Organ. for the Advan. of Pure Res.
(NP-17572) Avail: CFSTI

A helium filled diffusion cloud chamber was used as a neutron polarimeter. The polarization of neutrons from the reaction $^2D(d,n)^3He$ at 350 keV and a 46.5° reaction angle was determined. The value of the polarization was larger than values found in previous experiments. This was attributed to the absence of background radiation influences. NSA

N69-10822# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
VECTOR DOMINANCE MODEL AND SUM RULES FOR THE HIGH-ENERGY PHOTON-NUCLEON INTERACTION
S. B. Gerasimov 1968 14 p refs Presented at the 14th Intern. Conf. on High Energy Phys., Vienna
(JINR-E2-3926; CONF-680809-14) Avail: CFSTI

Within the vector dominance model the sum rules for the cross sections of vector-meson photoproduction and for the total cross sections of photon and meson interactions with nucleons are discussed. Author (NSA)

N69-10823# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ELASTIC ELECTRON SCATTERING BY NUCLEI AT AN ARBITRARY CHARGE DENSITY DISTRIBUTION
V. K. Luk'yanov, I. Ph. Petkov, and Yu. S. Pol 1968 16 p refs In RUSSIAN
(JINR-P4-3941) Avail: CFSTI

In a high-energy approximation (E >> V), a method is considered for calculating the cross section of the electron scattering by nuclei with an arbitrary Fermi-like distribution of the charge density. The method implies an expansion of the density over the orthonormalized function system, produced from the derivatives of the Fermi density, and the use of their pole singularities for the amplitude calculation. Good agreement with exact cross-section calculations, made with the Dirac equation, has been obtained. An example is given of using the method for the analysis of the experimental data. Author (NSA)

N69-10824# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ANHARMONIC EFFECTS IN NUCLEI OF THE TRANSITION REGION
R. V. Dzholos, U. M. Fainer, V. G. Solov'ev and K. M. Zheleznova 1968 6 p refs In RUSSIAN
(JINR-P4-3898) Avail: CFSTI

The admixtures of the two-phonon states to the lowest one-phonon states in some even-even nuclei of the transition region were considered. It was shown that these admixtures are not large but that they increase when approaching spherical nuclei. Author (NSA)

N69-10825# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
MAGNETIC DIPOLE INTERACTIONS IN DEFORMED NUCLEI
A. A. Kuliev and N. I. Pyatov 1968 25 p refs In RUSSIAN
(JINR-P4-3934) Avail: CFSTI

The spin polarization effects in odd-mass deformed nuclei are considered using the Tamm–Dancoff method. Expressions for the amplitudes of three-quasi particle admixtures to one-quasi particle states and the dispersion equation for the energy shift of single-particle levels due to the magnetic dipole interactions are derived. The theory is applied to calculate the intrinsic dipole magnetic moments of rare-earth nuclei. Author (NSA)

N69-10829# Puerto Rico Nuclear Center, Mayaguez.
A SYSTEMATIC EVALUATION OF CRITICAL EXPONENTS FOR THE MEAN FIELD AND ISING MODELS BELOW T_c
J. A. Gonzalo 1968 12 p refs
(Contract AT(40-1)-1833)
(TID-24510) Avail: CFSTI

It is proved that a fundamental scaling law defining ratios of critical exponents holds for the mean field and 2-D Ising model, while it is speculated that this type of scaling law may also apply for more complex models, such as the 3-D Ising model. This scaling law resembles the well known proposal of Domb and Hunter, suggesting fixed ratios of critical exponents. NSA

N69-10833 Illinois Univ., Urbana.
STRANGE PARTICLE PRODUCTION IN NEGATIVE PION PROTON AND POSITIVE PION NEUTRON INTERACTIONS AT 2.5 GeV/c
Raymond William Hanft (Ph.D. Thesis) 1967 201 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 68-1763

A bubble chamber experiment based upon 2.71×10^5 m π^- track length in hydrogen and 6.88×10^5 m π^+ track length in deuterium has been performed to study strange particle production. Cross sections for the π^-p reactions exhibit no marked departure from trends established by other experiments at nearby energies. In extracting information about π^+n interactions from the π^+D exposure it was found that 15 to 30% of events, depending on the final state particles, had protons with momentum greater than 250 MeV/c. These protons were not isotropic in the laboratory and therefore not spectators in the sense of the impulse approximation. Protons whose momentum lay in the interval 0 to 250 MeV/c were generally isotropic, and their momentum distribution agreed moderately well with a Hulthen distribution normalized over this interval. Dissert. Abstr.

N69-10834# University of South Florida, Tampa.
DECAYS OF NUCLEON RESONANCES BELOW 2 GeV INTO LAMBA K AND N η CHANNELS
S. R. Deans, W. G. Holladay (Vanderbilt Univ.), and J. E. Rush (Ala. Univ., Huntsville) [1968] 11 p refs Supported in part by NSF
Avail: Issuing Activity

The decay rates into ΛK and $N\eta$ channels of ten $T = 1/2$ nucleon resonances with masses below 2 GeV are compared with SU(3) symmetry. The placement of each of these resonances in an octet gives more consistent results with SU(3) than assignment to either a 10 or 27-fold multiplet, with the possible exception of the $P_{11}(1470)$ which is not easy to fit into an 8, 10 or 27. Agreement with SU(3) predictions for the decay rates is satisfactory for the $S_{11}(1550)$, $S_{11}(1710)$, $P_{11}(1751)$, $P_{13}(1863)$, $D_{13}(1525)$, and $F_{17}(1683)$, but is not impressive for the $P_{11}(1470)$, $D_{15}(1680)$ and $F_{15}(1690)$. Comparison of decay rates with values calculated by various models is presented. Author

N69-10835# California Univ., Berkeley. Lawrence Radiation Lab.
ANOMALOUS ABSORPTION OF ELECTRONS
Walter Lee Bell (Ph.D. Thesis) May 1968 189 p refs
(Contract W-7405-eng-48)
(UCRL-18158) Avail: CFSTI

The two-beam theory of electron diffraction in absorbing crystals is developed and its applicability to real diffracting media is investigated using electron micrographs of wedge-shaped foils of silicon and aluminum, obtained in a 100,000-V electron microscope. Evidence is presented that low-energy-loss electrons actually re-enter the dynamical beams, effectively amplifying the information carried by these beams. Such reentrainment of electrons makes the apparent incident intensity and the apparent mean parameter increase with foil thickness. The anomalous parameter is found not to be a crystal constant and depends upon the specific diffracting planes and, in addition, upon the structure of the diffracting crystal. In fcc aluminum, the anomalous absorption length increases with higher-order diffracting planes. In silicon, the irregularly spaced (111) diffracting planes exhibit less anomalous absorption than do the regularly spaced (220) planes. Author (NSA)

N69-10839# California Univ., Berkeley. Lawrence Radiation Lab.
PENETRATION OF HIGH-ENERGY HEAVY IONS, WITH THE INCLUSION OF COULOMB, NUCLEAR, AND OTHER STOCHASTIC PROCESSES
Gerald M. Litton, John Lyman, and C. A. Tobias May 1968 100 p refs
(Contract W-7405-eng-48)
(UCRL-17392-Rev) Avail: CFSTI

A general method has been developed for calculating Bragg curves, flux curves, and energy spectra resulting from the transport of high energy heavy ion beams in arbitrary media. The method takes into account the processes of energy loss from both electronic and nuclear elastic collisions, nuclear attenuation, small angle multiple scattering, and straggling, as well as effects due to initial energy and angular spreads of the beam. Contributions from secondary particles are not included. Calculations are made for ions of various atomic numbers and energies incident on different targets. It is found that for a given range in a particular target, the peak to plateau dose ratio goes through a maximum as the atomic number of incident ions increases. Similarly, the Bragg peak full width at half-maximum goes through a minimum. Another significant result is that for a given particle range, the average energy per atomic mass unit at the Bragg peak is nearly independent of the bombarding ion, and also of the target material. Author (NSA)

N69-10852# Stanford Univ., Calif. Stanford Linear Accelarator Center.
IS THE POMERANCHON AN ORDINARY REGGE TRAJECTORY?
Haim Harari Aug. 1968 29 p refs Presented at the High Energy Phys. Symp., Colorado Univ., Boulder, Jun. 1968
(SLAC-PUB-463) Avail: CFSTI

The possible relation between Regge poles and cuts and various optical models for high-energy hadron collisions is discussed, and a specific model for the Pomeranchuk trajectory is considered. The point of view is presented that there are already a sufficiently large number of experimental facts which demand exotic Regge poles and possibly cuts, that it is probably possible to fit all existing data with such poles and cuts, in many cases the fits are insignificant because the assumed model has too much freedom, and there may exist some other physical picture of high-energy reactions which is outside the usual model of t-channel exchange of poles and cuts. Some general questions related to the possible peaceful coexistence of an optical picture and a Reggeistic description are discussed. The nature of the Pomeranchuk trajectory and its possible diffractive origin are analyzed, and a model which distinguishes between the Pomeranchon and the other ordinary trajectories is presented. NSA

N69-10857# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
RELATIVISTIC TWO BODY PROBLEM AND FINITE-DIFFERENCE CALCULUS
V. G. Kadyshevskii, R. M. Mir-Kasimov, and N. B. Skachkov 1968 25 p refs
(JINR-E2-3949) Avail: CFSTI

For the purpose of solving the relativistic Schrodinger finite-difference equation, a special type of finite-difference calculus is developed. Solutions of the above equation in the absence of interactions are investigated, and the relativistic analogs of Wronskians and Green functions are found. Author (NSA)

N69-10858# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SCHROEDINGER DIFFERENCE EQUATION FOR TWO RELATIVISTIC PARTICLES IN THE SIMPLEST CASES
V. G. Kadyshevskii, R. M. Mir-Kasimov and N. B. Skachkov 1968 20 p refs
(JINR-E2-3950) Avail: CFSTI

On the basis of the relativistic finite difference Schroedinger equation the relativistic analogs of the current, continuity equation, and phase shifts are introduced. Exact solutions of some problems with simple potentials were found. Author (NSA)

N69-10859# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SUMMATION OF ASYMPTOTICS IN PERTURBATION THEORY AND HIGH-ENERGY BEHAVIOUR
A. V. Efremov, I. F. Ginzburg, and V. G. Serbo 1968 23 p refs Presented at the 14th Intern. Conf. on High Energy Phys., Vienna
(JINR-E2-3917; CONF-680809-16) Avail: CFSTI

Assuming the bare charge to be finite a summation was made of the senior asymptotical terms of all the Feynman graphs in the theory $g\bar{\Psi}\gamma^5\Psi\phi + h\phi^4$. As a result the square-root branching points on j-plane appear. This leads to a decrease of the total cross section of pion and nucleon scattering not slower than $[\log(2E_{lab}/m)]^{-3/2}$ in the energy region $1\ \text{GeV} << E_{lab} \leq 200\ \text{GeV}$ and the ratio $\text{Re}\ T/\text{Im}\ T \sim [\log(2E_{lab}/m)]^{-1}$. The factorization relation, $\sigma_{\pi\pi}\sigma_{nn} = \sigma^2_{\pi n}$ is automatically fulfilled. Author (NSA)

N69-10878# Joint Inst. for Nuclear Research, Dubna (USSR).
SEARCH FOR RESONANCES IN Λ_p SYSTEM IN COLLISIONS OF NEUTRONS WITH CARBON NUCLEI AT AN AVERAGE MOMENTUM OF 7 TO 8 GeV/c
B. A. Shakhbazyan and V. I. Moroz 1968 14 p refs
(JINR-E1-4022) Avail: CFSTI

The strong peak found in the Λ_p system effective mass spectrum in the mass interval of 2053 to 2093 MeV is proved to be due to the strong interaction of Λ-hyperons with protons in final state. Author (NSA)

N69-10877# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
INVESTIGATION OF THE ELECTRON-PHOTON SHOWERS WITH THE SCINTILLATION COUNTERS
O. A. Zamidoroga, V. M. Kut'in, Yu. D. Prokoshkin, and V. M. Tsupko-Sitnikov 1968 14 p refs In RUSSIAN
(JINR-P1-3976) Avail: CFSTI

Cascade curves, fluctuations of the secondary electron number and the angular divergence of the showers, produced in lead by 115- and 217-MeV electrons, were measured. The characteristics are determined on the basis of an analysis of the amplitude distributions of the scintillation counter pulses, which is used to measure the number of particles in the shower. The measurements were carried out at different values of cutoff energy of the secondary electron spectrum. Author (NSA)

N69-10894# California Univ., Berkeley. Lawrence Radiation Lab.
ZERO STRANGENESS RESONANCE PRODUCTION IN 6 GeV/c PROTON-PROTON COLLISIONS
Robert Ronald Kinsey (Ph.D. Thesis) Jun. 1968 132 p refs
(Contract W-7405-ENG-48)
(UCRL-17707) Avail: CFSTI

Approximately 33,000 four-pronged proton-proton interactions at 6 GeV/c were examined for the production of nonstrange meson and baryon resonances. These events were found by scanning approximately 112,000 pictures taken in the LRL 72-in. hydrogen bubble chamber. The reactions studied in detail and their cross sections are (1) $pp \rightarrow pp\pi^+\pi^- \; 3.2 \pm 0.3$ mb, (2) $pp \rightarrow pn\pi^+\pi^+\pi^- \; 2.9 \pm 0.4$ mb, and (3) $pp \rightarrow pp\pi^+\pi^-\pi^0 \; 2.4 \pm 0.2$ mb. Proton-proton interactions were studied by others in this energy region and this experiment agrees with these studies in the general features of reaction (1). Reaction (1) is dominated by the pseudo-two-body final states NN^* and $N\pi N^*$ produced in a peripheral manner. Fits to the various possible final states were made and are reported. Data from this reaction were also compared to the peripheral one-pion exchange (OPE) model and the results are given. Author (NSA)

N69-10895# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
NEW SHORT-LIVED ACTIVITIES Y 163, TM 165, TM 163, TM 161, TM 159
K. Ya. Gromov, Zh. T. Zhelev, V. G. Kalinnikov, Z. Malek, N. Nenov et al 1968 17 p refs In RUSSIAN
(JINR-P6-3945) Avail: CFSTI

Five new activities were identified according to their genetic connection with the daughter activities. The Szillard–Chalmers reaction was used in phthalocyanine complexes. It is possible that the isomeric states ^{165m}Tm, ^{163m}Tm, and ^{161m}Tm are connected with the Nilsson 7/2 +/404/ or 7/2 −/523/ states. Author (NSA)

N69-10901# Iowa State Univ. of Science and Technology, Ames.
THE RADIOACTIVE DECAY OF Sr-91
James Edward Solecki (M.S. Thesis) May 1968 38 p refs
(Contract W-7405-ENG-82)
(IS-T-234) Avail: Issuing Activity

A high resolution Ge(Li) spectrometer was employed to study the gamma rays associated with the beta decay of ^{91}Sr. An isotopically pure source was produced by the decay of a sample of ^{91}Kr provided by the on-line isotope separator system. Energies and relative intensities of twenty-one gamma rays were measured. The energies of the strong gamma rays were determined to within ±0.1 keV, an order of magnitude improvement in accuracy over the previously reported data. Gamma–gamma coincidence measurements were performed to verify some of the cascade transitions. From these data and the results of studies at other laboratories of the beta spectrum of ^{91}Sr, the ^{92}Zr(d,^{3}He) reaction, and the ^{89}Y(t,p) reactions, a decay scheme of ^{91}Sr and an energy-level diagram for ^{91}Y were deduced. The half-lives of ^{91}Sr and the isomeric state in ^{91}Y were measured to be 9.48 ± 0.01 hr and 49.71 ± 0.04 min, respectively. Author (NSA)

N69-10915# Illinois Univ., Urbana.
OBSERVATION OF THE A_2 NEGATIVE MESON IN 5 GeV/c NEGATIVE PION–PROTON REACTION
G. Ascoli, C. A. Bridges, H. B. Crawley, B. I. Eisenstein, R. W. Hanft et al 1968 15 p Presented at the 14th Intern. Conf. on High Energy Phys., Vienna, 28 Aug.–5 Sep. 1968
(COO-1195-133; CONF-680809-20) Avail: CFSTI

In a 150,000 picture (≈6 events per microbarn) exposure in the 72" hydrogen bubble chamber at Berkeley the A_2 meson was studied in 4-prong events. In particular the reaction $\pi^- p \rightarrow A^-_2 p$ with subsequent decay into $\rho^0\pi^-$, $\eta^0\pi^-$, and $\chi^0\pi^-$ was observed. Results on the branching ratios and on the decay angular distributions for $A_2 \rightarrow \eta^0\pi^-$ have been reported previously. In the previous work the A_2 was treated as a single resonance using the mass interval 1.20–1.40 GeV. The results obtained on the CERN mass spectrometer indicate that the A_2 may consist of two separate resonances or may be a double pole. In view of this possibility the A_2 data are presented with particular emphasis on the split vs. single A_2 question and also on the possible spin-parity assignments for the lower and upper A_2 if the A_2 is split. Author (NSA)

N69-10916# Brookhaven National Lab., Upton, N. Y.
STUDY OF COHERENT K NEGATIVE INTERACTIONS ON NUCLEI AT 5.5 AND 12.7 GeV/c
H. H. Bingham, C. W. Farwell, and W. B. Fretter 1968 17 p refs Presented at the 14th Intern. Conf. on High Energy Phys., Vienna, 28 Aug.–5 Sep. 1968
(BNL-12739; CONF-680809-15) Avail: CFSTI

The observation and preliminary analysis of $K^-\pi^+\pi^-$ final states produced coherently on neon nuclei by K− mesons of 5.5 and 12.7 GeV/c are reported. Approximately 1000 events at 5.5 GeV/c and 3000 at 12.7 GeV/c were obtained from two exposures in the hydrogen–neon bubble chamber and fitted to the 1c reaction $K^- + n \rightarrow K^- + \pi^+ + \pi^- + n$. There is evidence for $K^*(890)$ and ρ production. The $K\pi\pi$ mass spectra at 5.5 and 12.7 GeV/c for $K^-\pi^+$ masses in the K^* band show evidence of peaking at 1.26 GeV with a width of 300 MeV, in the region of the Q enhancement. NSA

N69-10937# California Univ., Berkeley. Lawrence Radiation Lab.
STOPPING POWER AND RANGE FOR ANY NUCLEUS IN THE SPECIFIC ENERGY INTERVAL 0.01– TO 500–MeV/amu IN ANY NONGASEOUS MATERIAL
Palmer G. Steward (Ph.D. Thesis) May 1968 171 p refs
(Contract W-7405-ENG-48)
(UCRL-18127) Avail: CFSTI

A method is presented for calculating range and stopping-power data for any heavy ion with $0.01 \leq \epsilon \leq 500$ MeV/amu incident upon any nongaseous stopping medium. The method is incorporated into a FORTRAN 4 computer program. Results for H, ^{4}He, ^{12}C, ^{20}Ne, ^{40}Ar, ^{84}Kr, ^{131}Xe, and ^{222}Rn ions each incident upon H_2O, Al, Cu, Ag, Pb, and U are presented. For ions at low energy with $Z \leq 10$, the program uses experimental data. For ions with $Z > 10$, the nuclear and electronic stopping-power theory developed by Lindhard et al., is adjusted to fission-product range data at low energy; for intermediate energies, charge-state data developed from experimental Ar range–energy data in Al is extended to other ions and stopping

media. Bethe's theory is used for all ions at high energy. Bloch's theory is discussed, although it is not used in the method. The particle ranges calculated by the method are path-length ranges and do not include the effects of multiple scattering. A method for calculating projected range at low energies is presented as an appendix. Author (NSA)

N69-10938# California Univ., Berkeley. Lawrence Radiation Lab.
RANGE ENERGY TABLE FOR HEAVY PARTICLES IN SILICON
Hans Bichsel and Cristoph Tschalaer Jul. 1968 32 p refs
(Contract W-7405-ENG-48; Grant PHS-CA-08150)
(UCRL-17663-Rev-1) Avail: CFSTI

Stopping-power S and range R tables for protons, deuterons, tritons, ^{3}He, ^{4}He and ^{7}Li ions of energies between 1– and 200–MeV penetrating silicon absorbers are presented. Auxiliary data include tables for the coefficients C and α needed for the approximate expression $S = C \cdot E^{\alpha}$ and figures giving the energy dependence for the coefficients of $R = C_R \cdot E^{\beta}$. A short review is given of principles to be considered in detector applications. Author (NSA)

N69-10946# Israel Atomic Energy Commission, Tel Aviv.
A THEORETICAL COMPARISON BETWEEN THE TOF AND DAS DIFFRACTION METHODS
A. Epstein and H. Shaked Dec. 1967 16 p refs
(IA-1166) Avail: Issuing Agency

Two neutron diffraction methods, the double-axis spectrometer (DAS) and the time of flight (TOF) are compared. The experimental apparatus and resolution are discussed. Author (NSA)

N69-10949# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Institut.
GENERAL CONSIDERATION OF CERTAIN QUESTIONS OF THE KINETICS OF A NEUTRON FLUX IN NON-MULTIPLYING AND MULTIPLYING MEDIA WITH USE OF THE HIGHER HARMONICS
V. Ya. Pupko 1967 114 p refs In RUSSIAN; ENGLISH summary
(FEI-103) Avail: Issuing Activity

Equations of the kinetics of neutrons for multiplying and non-multiplying media are derived which consider the higher harmonics of neutron flux. The method described is used to obtain a precise solution for equations for the flux and importance of neutrons in a bare intermediate reactor in age-diffusion approximation. NSA

N69-10957# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
SEARCH FOR MULTIPION RESONANCES WITH I-SPIN EQUALS 2
W. Katz, T. Ferbel, P. Slattery, T. Yamanouchi, and H. Yuta 30 Jul. 1968 15 p refs Presented at 14th Intern. Conf. on High Energy Phys., Vienna, 1968
(Contract AT(30-1)-875)
(UR-875-249; CONF-680809-12) Avail: CFSTI

An 84,000 picture exposure of the 80-inch deuterium bubble chamber to 7-GeV/c negative pions was scanned for the reactions $\pi^- + d \rightarrow 2p + \pi^+ + 3\pi^-$ and $\pi^- + d \rightarrow 2p + \pi^+ + 3\pi^- + \pi^0$. A search was made for I = 2 mesons in the 4π and 5π states which were predicted to exist on the basis of symmetry. The results indicate that if these mesons exist and have widths below 160 MeV then they are produced in association with protons only with a cross section below 3 μb. NSA

N69-10958# Brookhaven National Lab., Upton, N. Y.
THEORY OF DIPOLE PERTURBATIONS IN THE AGS
J. C. Herrera and M. Month 12 Jun. 1968 14 p
(BNL-12756) Avail: CFSTI

The motion of a particle in the Brookhaven AGS for an arbitrary distribution of perturbing dipole fields is studied. The general solution to the equation of motion is derived, and the stability and periodicity of the orbits characterizing such fields are investigated. The problem of an adiabatic increase in the perturbing dipole fields is also considered. NSA

N69-10959# Purdue Univ., Lafayette, Ind. Nuclear Physics Lab.
RESEARCH IN NUCLEAR PHYSICS Progress Report, 1 Oct. 1967–1 Jun. 1968
R. M. Steffen 15 Jun. 1968 99 p refs
(Contract AT(11-1)-1748)
(COO-1746-8; PR-1) Avail: CFSTI

Developments in the experimental research program included the analysis of data on the reactions $^{12}C(^{3}He,\alpha)^{11}C$ and $^{16}O(^{3}He,\alpha)^{15}O$ and on α elastic and inelastic scattering by ^{19}F; measurement of the static quadrupole moments of the first excited 2^+ states of ^{74}Ge, ^{76}Ge, ^{56}Fe, and ^{108}Pd; investigation of the effect of magnetic hyperfine interactions on γ–γ directional correlations from ^{169}Tm in Fe; measurement of the g-factors of excited states in ^{75}As, ^{190}Os, and ^{192}Pt; measurement of the hyperfine field at ^{103}Rh in Fe at 305.5°K; measurement of multipole mixing ratios for transition in the decay of ^{192}Ir; measurement of conversion electron particle parameters for M4 transitions in ^{207}Pb, ^{197}Hg, and ^{117}Sn; measurements of β–γ directional correlations for first-forbidden transitions in the decay of ^{124}Sb and for K-forbidden transitions in the decay of ^{160}Tb; β–γ circular polarization measurements on ^{60}Co; and measurement of the lifetimes of short-lived states in ^{114}Cd, ^{60}Ni, ^{192}Pt, and ^{46}Ti. NSA

N69-10960# Western Washington State Coll., Bellingham.
FISSION STUDIES ON ELEMENTS BELOW POLONIUM Progress Report, 1 Jul. 1967–1 Jul. 1968
Edward F. Neuzil Jul. 1968 10 p refs
(Contract AT(45-1)-1759)
(RLO-1759-14) Avail: CFSTI

The fission reactions $^{204}Pb(\alpha,f)$ and $Ta(\alpha,f)$ were investigated. Cross sections and fission-fragment mass distribution curves were obtained. NSA

N69-10964# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
FISSION OF EXCITED NUCLEI
Yu. Ts. Oganesyan 1968 21 p refs
(JINR-E7-3942) Avail: CFSTI

Nuclear fission at an excitation energy of more than 50 MeV was investigated. It is shown that the statistical theory determines a nuclear state at the saddle point rather well, but appears to be inapplicable for describing the process at the scission point. This conclusion is based on the experiments on mass and charge distributions of fission fragments for nuclei in the wide Z^2/A range. Author (NSA)

N69-10978# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL STUDY OF THE PROPAGATION OF SLOW NEUTRONS CLOSE TO THE SOURCE IN THE UNBOUNDED ATMOSPHERE [EKSPERIMENTAL'NOYE IZUCHENIYE RASPROSTRANENIYA MEDLENNYKH NEYTRONOV V BESKONECHNOY VOZDUSHNOY SREDE VBLIZI ISTOCHNIKA]
S. F. Degtyarev et al 4 Jan. 1968 9 p refs Transl. into ENGLISH from Vopr. Fiz. Zashchity Reaktorov, Sb. Statei (Moscow), 1966 p 206–209
(AD-674888; FTD-MT-24-354-67) Avail: CFSTI CSCL 20/8

The density of thermal neutrons is experimentally studied to provide data for computing capture gamma-radiation in air. A Po-Be fast neutron source was used in a paraffin block having walls 20 cm

thick. Thermal neutrons are taken as those with an energy below the cadmium threshold $E_n < 0.4$ MeV and neutrons with greater energies are called fast neutrons. An SNM-O boron counter was used for measuring the density of thermal neutrons. The source and detector were located at an altitude of 60 m to eliminate the effect of neutrons scattered from the earth. Three quantities were measured directly: (1) the density of neutrons throughout the entire spectrum escaping from the paraffin block; (2) the density of thermal neutrons formed from the fast neutrons; (3) the density of fast neutrons escaping from the source and propagated in the atmosphere. The results show that the fraction of thermal neutrons produced by attenuation in the atmosphere is small in comparison with the thermal neutrons for the given spectrum. A comparison of experimental and theoretical data for thermal neutron distribution shows excellent agreement at a source temperature of 293 degrees K with some discrepancy when the source temperature is increased to 440 degrees K. TAB

N69-10983# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

EXCHANGE DEGENERACY AND RELATIONS BETWEEN CROSS-SECTIONS AT HIGH ENERGIES

R. M. Mir-Kasimov 1968 13 p refs In RUSSIAN
(JINR-P2-3944) Avail: CFSTI

A number of relations are obtained between the cross sections of meson–nucleon and nucleon–nucleon collisions at high energies in the scheme using the Regge pole theory and the exchange degeneracy hypothesis. Author (NSA)

N69-10990# California Univ., San Diego.

INTERMEDIATE STRUCTURE IN RESONANCES

Gerald Law Payne (Ph.D. Thesis) Dec. 1967 186 p refs
(Contract AT(11-1)-GEN-10)
(ICSD-10-P-11-75) Avail: CFSTI

The effects of two-particle-one-hole states on the elastic cross section for the scattering of neutrons from nuclei are studied. The intermediate resonances are observed when the averaging width is larger than the widths and spacings of the compound nucleus states but smaller than the width of the structure in the optical model cross section. It is shown that if these states are to be observed experimentally, their width due to decay back into the initial single particle state must be less than their width for decay into more complicated configurations. Also, their spacing must be larger than their widths. The self-consistent K-matrix methods developed by Brueckner are used to evaluate the widths for these states in order to see when the above conditions are satisfied. For the heavy nuclei, the two conditions are not satisfied. Consequently, for heavy nuclei the resonances due to the two-particle-one-hole states should not be observable. The widths for a number of spherical nuclei are calculated using a shell model basis. Author (NSA)

N69-10991# Academy of Sciences (USSR), Moscow.

THE INTENSITIES OF PARTIAL RADIATIONAL TRANSITIONS INTO THE FUNDAMENTAL AND FIRST EXCITED STATES IN RESONANCES OF THE ISOTOPE Gd^{156}

L. S. Danelyan, B. V. Efimov, and S. K. Sotnikov 1967 20 p refs In RUSSIAN
(IAE-1443) Avail: CFSTI

Measurements with a two-crystal scintillation spectrometer were made of the total values of the intensities of gamma transitions into fundamental and first excited states in 23 resonance reactions $^{155}Gd(n,\gamma)^{156}Gd$. The experimental distribution of the intensities agrees better with two component Porter-Thomas distributions with different average values of the intensity than with $\gamma = 1$ and $\gamma = 2$ distributions. Analysis of the available data indicates the possibility of the existence of a correlation between the magnitudes of the intensities and the spins of the initial states. Author (NSA)

N69-11018# United Kingdom Atomic Energy Authority, Harwell (England).

ELEMENTARY PROCESS OF BREMSSTRAHLUNG PRODUCTION

W. Nakel Nov. 1967 4 p refs Transl. into ENGLISH from Phys. Lett., no. 25A, 1967 p 569–570
(NP-TR-1688) Avail: CFSTI

By using a coincidence method the angular distribution of bremsstrahlung is measured for a definite energy loss and a definite angle of the outgoing electron. A comparison with theoretical predictions is given. Author (NSA)

N69-11030# California Univ., Riverside.

REACTION POSITIVE PION PLUS PROTON YIELDS DELTA RESONANCE (1236) PLUS NEUTRAL PION BETWEEN 1850 AND 2010 MEV CENTER OF MASS ENERGY

Sun-Yiu Fung, Anne Kernan, George B. Kalmus, and Robert W. Birge Jul. 1968 12 p refs Presented at 14th Intern. Conf. on High Energy Phys., Vienna
(Contract AT(11-1)-34)
(UCR-34-P-107-72; CONF-680809-17) Avail: CFSTI

Cross sections and angular distributions for the reaction $\pi^+ + p \rightarrow \Delta^{++}(1236) + \pi^0$ at incident pion momenta 1.34, 1.42, and 1.68 GeV/c are given. From a study of the angular distributions the cross section for the partial wave amplitude F37 in this channel is estimated at 2.8 ± 0.6 mb and $4.5^{+0.5}_{-0.8}$ mb at 1.34 and 1.42 GeV/c respectively. These cross sections give a value 0.20 ± 0.04 for $x_{\pi N} X_{\Delta\pi}$ for the F37 resonance $\Delta(1950)$. Author (NSA)

N69-11031# Rochester Univ., N. Y. Dept. of Physics and Astronomy.

SEARCH FOR NEW MESON RESONANCES IN POSITIVE KAON PROTON INTERACTIONS AT 12.7 GeV/c

J. C. Berlinghieri, M. S. Farber, T. Ferbel, B. E. Forman, A. C. Melissinos et al 30 Jul. 1968 13 p Presented at the 14th Intern. Conf. on High Energy Phys., Vienna
(Contract AT(30-1)-875)
(UR-875-250; CONF-680809-21) Avail: CFSTI

In a study of K+p interactions at 12.7 GeV/c a search was made for meson resonances having any one of the following properties: (a) a strangeness of S = 2, (b) S = 1 and isotopic spin of I = 3/2, or (c) S = 1, I = 1/2 and decaying into an antihyperon ($\bar{Y}$) and a nucleon (N). Resonances having properties (a) and (b) would belong to the larger, and as yet unobserved, multiplets of SU(3). The results of this experiment indicate that if these mesons exist and have masses < 4 GeV then they are produced only with cross sections < 5 μb. Author (NSA)

N69-11033# Argonne National Lab., Ill.

ANGULAR DISTRIBUTION OF THE RECOIL NUCLEI IN THE REACTION C^{12} (p, pn) C^{11} [UGLOVOE RASPREDELENIE YADER OTDACHI V REAKTSII C^{12} (p,pn)C^{11}]

F. P. Denisov, V. P. Milovanov, V. N. Pokrovskii, P. A. Cherenkov, and I. A. Yutlandov [1968] 5 p refs Transl. into ENGLISH of the Russian Preprint, Moscow, Acad. of Sci., no. 122, 1967 4 p
(ANL-TRANS-657) Avail: CFSTI

The angular distribution of recoil nuclei in the reaction $^{12}C(p,pn)^{11}C$ was measured at a proton energy of 660 MeV. The targets used possessed a thickness of ≈5.5 mg/cm² and 100 μg/cm². The measured distribution is practically the same in both cases and exhibits a tendency toward a maximum at $\theta = 75°$ (lab. system of coordinates). Author (NSA)

N69-11034# United Kingdom Atomic Energy Authority, Harwell (England).
THE POSSIBILITY OF MEASURING THE MAGNETIC MOMENT OF THE ISOBAR Δ RESONANCE (1236) IN RADIATIVE π^+p SCATTERING
L. A. Kondratyuk and L. A. Ponomarev [1968] 16 p refs Transl. into ENGLISH from the Russian Report ITEF-528
(NP-TR-1892) Avail: CFSTI

A method is described for measuring the magnetic moment of the isobar $\Delta^{++}(1236)$ in the process $\pi^+p \rightarrow \pi^+p\gamma$. The differential cross section for this process was determined for an incident pion energy close to the resonance energy, for γ quanta at large angles θ_1 and θ_2 relative to the directions of the two pions. It is shown that the values of $d\sigma/d\omega$ with and without allowance for the magnetic moment of Δ^{++} may differ by an average factor of 2 in the γ quantum energy range 30 MeV < ω < ω_{max} and the angle range 135° < θ_1, θ_2 < 180°, if $\mu_\Delta = 2\mu_p$ as predicted by SU(6) symmetry. The value of $d\sigma/d\omega$ itself is found to be $\approx 10^{-30}$ cm^2/100 MeV. An estimate of background is also made. Author (NSA)

N69-11036# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ALGEBRA OF CURRENTS ON THE LIGHT CONE
I. Ersak and Ya. Shtern 1968 19 p refs
(JINR-E2-3990) Avail: CFSTI

On the basis of the observation that the fixed-mass sum rules are Fourier transforms of the commutators of currents on a light-like hyperplane a new treatment of the algebra of currents is proposed. It consists in the use of the currents integrated over a light-like hyperplane ("light-like" charges) and thus includes the commutators of currents on the whole light cone. An algebra of the light-like charges is a sufficient assumption for the derivation of fixed-mass sum rules and may be represented in the one-particle space with any momenta. Hence this extension of the usual equal time current algebra allows one to abandon the methods like $p_2 \rightarrow \infty$ without losing any of its advantages. Author (NSA)

N69-11065# European Organization for Nuclear Research, Geneva (Switzerland).
POLARIZED SOURCES
R. Beurtey [1968] 15 p refs Transl. into ENGLISH of a French report
(LA-TR-68-37) Avail: CFSTI

Recent developments in polarized ion sources are described. Topics discussed include charge exchangers for producing high-intensity beams, spin exchangers, and the acceleration of polarized deuterons in synchrotrons. NSA

N69-11079# California Univ., Berkeley. Lawrence Radiation Lab.
IS THERE EVIDENCE FOR AN H MESON? (IS IT JUST THE ETA'?)
A. Barbaro-Galtieri and P. Soeding Apr. 1968 24 p refs Presented at the Conf. on Exptl. Meson Spectry., Philadelphia, 26-27 Apr. 1968 Submitted for publication
(Contract W-7405-ENG-48)
(UCRL-18271; CONF-680428-10) Avail: CFSTI

Analysis of π^+p and π^+n data, in the 3- to 4-GeV/c incident π^+ momentum range, shows that at present there is no convincing evidence for existence of the so-called H meson (M ≈ 990 MeV, suggested quantum numbers $I(J^P) = 0(1^+)$. The enhancement observed in the neutral three-pion invariant mass distribution near 990 MeV can be attributed to the $\pi\pi\gamma$ decay mode of the η'. Author (NSA)

N69-11094# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
UPPER LIMIT OF THE RADIUS OF THE ELEMENTARY PARTICLES AND THE LOWER BOUND OF THEIR FORMFACTORS
V. Baluni, Nguyen Van Hieu, and V. A. Suleimanov 1968 11 p refs
(JINR-E2-3986) Avail: CFSTI

On the basis of the analyticity of the form factor the upper limit of the radius of the elementary particles is obtained. Also the lower bound for the form factor in the region $t < 0$ is established. Author (NSA)

N69-11101# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
CONCERNING THE RENORMALIZABLE THEORY OF WEAK INTERACTIONS
E. P. Shabalin 1967 18 p refs In RUSSIAN; ENGLISH summary
(ITEF-580) Avail: Issuing Activity

The Tanikawa-Watanbe model for renormalizable theory of the weak interaction is investigated in view of recent experimental data. The variant of the theory, as presented by Tanikawa and Watanabe, is shown to be in contradiction with the available data. A new variant is established that is in agreement with modern data. Corrections and correlations for the e^+p, M^+p scatterings due to the weak interactions are substantial in the new variant of the theory, so the validity of the theory may be tested if the experimental precision be increased. Author (NSA)

N69-11102# Argonne National Lab., Ill.
EFFECT OF SUBSHELLS WITH A NEUTRON NUMBER N = 152 UPON THE QUANTITY γ_n/γ_f IN REACTIONS WITH HEAVY IONS [VLIYANIE PODOBOLOCHKI S CHISLOM NEITRONOV N = 152 NA VELICHINU γ_n/γ_f V REAKTSIYAKH S TYAZHELYMI IONAMI]
V. L. Mikheev and S. M. Polikanov 1968 7 p refs Transl. into ENGLISH from JINR D7-3548 (CONF-661035)
(ANL-TRANS-636) Avail: CFSTI

The mean ratio of the neutron width and fission width for elements with subshells with 152 neutrons was determined through study of the reactions $^{239}Pu(^{18}O,5n)^{252}No$, $^{239}Pu(^{12}O,4n)^{253}No$, $^{242}Pu(^{18}O,4n)^{254}No$, $^{242}Pu(^{18}O,5n)^{255}No$, $^{242}Pu(^{18}O,4n)^{256}No$, and $^{242}Pu(^{18}O,5n)^{255}No$. NSA

N69-11122# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
DOUBLE CHARGE EXCHANGE OF NEGATIVE PION MESONS AT THE LOW ENERGY
Yu. A. Batusov, S. A. Bunyatov, V. M. Sidorov, and V. A. Yarba 1968 6 p refs In RUSSIAN
(JINR-P1-3946) Avail: CFSTI

The double charge exchange of π^--mesons on nuclei in the photoemulsion was detected at an energy at 15 MeV. The total cross section is $(4.6 \pm 3.4)\ 10^{-29}$ cm2 at this energy. The process of the double charge exchange for slow π^--mesons in the capture by ^{58}Ni nuclei was investigated. The relative probability of this reaction compared to the total probability for π^--mesons capture in ^{58}Ni is found to be smaller than 3.10^{-6}. Author (NSA)

N69-11128# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronphysik und Reatortechnik.
NEW ROSSI ALPHA MEASUREMENT METHODS
M. Edelmann Jan. 1968 114 p refs Transl. into ENGLISH from German Rept. INR-4/68-15
(LA-TR-68-39) Avail: CFSTI

Under certain conditions in Rossi-α measurements the correlation amplitude of pulses may be in error because of dead time in the analyzer or in the neutron detectors. This falsification of the correlation amplitude is examined and measurement methods for determining the undisturbed correlation function are developed. The signal-to-noise ratio was increased by periodic interruption or by scaling the sequence of initiating pulses. Measurements without dead time were simulated with the aid of a magnetic tape instrument. To test the experimental results, the effect of small dead times in the initiating pulse and count-pulse channels on the correlation channel was calculated. Good agreement was obtained between theory and experiment. The statistical measuring errors were included in a general error formula which makes it possible to determine the most favorable testing conditions or to decide in advance whether Rossi-α measurements can be carried out. NSA

N69-11138# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

THE ANALYSIS OF Ge(Li) GAMMA RAY SPECTRA WITH AN ON-LINE COMPUTER

B. J. Allen, G. D. Upex, and G. D. Trimble Jun. 1968 19 p refs

(AAEC/TM-458) Avail: CFSTI

The application of a small on-line computer to data-taking and analysis of Ge(Li) gamma ray spectra is described. Both symbolic and FORTRAN programs are included and the merits of on-line analysis discussed. Author (NSA)

N69-11161# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.

AN ALTAC CODE PROGRAM FOR THE INTENSITIES OF NEUTRON DIFFRACTED FROM POLYCRYSTALLINE SAMPLES

Z. Friedman and H. Shaked Dec. 1967 23 p refs

(IA-1169) Avail: CFSTI

An ALTAC III code for the intensities of neutrons diffracted from polycrystalline samples is given. The code is valid for the seven crystal systems and arbitrary direction of spin at any atomic position. Author (NSA)

N69-11181# Eidgenoessiches Institut fuer Reaktorforschung, Wurenlingen (Switzerland).

TOTAL CROSS SECTION OF CADMIUM FOR NEUTRONS OF ENERGY BETWEEN 0.01 eV AND 10 eV

F. Widder and J. Brunner Jun. 1968 12 p refs

(EIR-134) Avail: CFSTI

The total cross section of cadmium for 0.01- to 10-eV neutrons was measured using a fast chopper. Parameters for the 0.178-eV resonance were determined. NSA

N69-11185# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoi Energii.

PARTICLE DRIFT MOTION IN A SYSTEM WITH MINIMUM B [DVIZHENIE PROLETNYKH CHASTITS V SISTEME S MINIMUMOM B]

Yu. V. Skosyrev and E. I. Yurchenko 1967 12 p refs In RUSSIAN

(IAE-1488) Avail: CFSTI

Particle in-flight motion in a system with helical magnetic axes and stabilizing fields securing a minimum B was studied. Experimental data are presented for rotational transformation angles and drift surface configurations, and theoretical and experimental correlations are discussed. NSA

N69-11187# Gulf General Atomic, San Diego, Calif.

LATTICE DYNAMICS AND NEUTRON SCATTERING OF BEO

G. Borgonovi 3 Jul. 1968 33 p refs

(Contract AT(04-3)-167)

(GA-8758) Avail: CFSTI

For the calculation of neutron scattering by BeO, knowledge of its atomic motions is required. Since the work of Young and Koppel in 1966, elastic, preliminary neutron scattering, and Raman data become available and are used in the present calculations which use Born–von Karman vibrational dynamics. Inelastic and elastic scattering cross sections of BeO are calculated, and the total cross section is in good agreement with experimental data. NSA

N69-11217# Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics.

DATA COMPILATION OF BARYON-BARYON INTERACTIONS. 2: PROTON-NEUTRON COLLISIONS BETWEEN 1 AND 27 GeV/c

G. Alexander, O. Benary, and U. Maor 1968 23 p refs

(NP-17578) Avail: CFSTI

A data compilation on neutron-proton interactions at 1 to 27.0 GeV/c obtained from p + d and n + p interactions using accelerator-generated beams is presented. These data were published during the period from January 1, 1954 to March 31, 1968. A list of references, curves showing the n + p total cross section in the isospin I = 0 state [$\sigma T_{I=0} = 2\sigma T_{np} - \sigma T_{pp}$], elastic and charge exchange cross sections, and polarization curves at various incoming momenta are included. NSA

N69-11221# Wuerzberg Univ. (West Germany).

ASYMMETRICAL PAIR PRODUCTION IN QUANTUM ELECTRODYNAMICS WITH MODIFIED FERMION PROPAGATOR

H. Fraas Hamburg, West Ger. Deutsches Elektronen-Synchrotron Jun. 1968 12 p refs

(DESY-68/36) Avail: CFSTI

One- and two-photon vertices are constructed which restore gauge-invariance of the amplitude for pair production in QED with modified fermion propagator. By means of the modified Bethe–Heitler cross section, the sensitivity of asymmetrical pair production against a modification of the fermion propagator is discussed and compared with that of wide-angle production of symmetrical pairs. Author (NSA)

N69-11224# Eidgenoessiches Institut fuer Reaktorforschung, Wurenlingen (Switzerland).

S_∞ TRANSPORT THEORY IN PLANE GEOMETRY

J. Mennig and J. T. Marti Apr. 1968 30 p refs

(EIR-105) Avail: CFSTI

A semi-analytical method for solving the monoenergetic transport equation in plane geometry is developed in which the slab system is subdivided into a number of discrete space points in x, while the angular variable is treated analytically. General boundary conditions are introduced allowing finite multilayer slabs, cells and shielding problems with specified incident angular distribution of neutrons to be handled by the same formalism. Analytical expressions are derived for the angular distributions and fluxes are obtained by solving a matrix problem, where the matrix elements are integrals over rational functions of the angular variable. Calculation times are comparable to low order S_N calculations. Author (NSA)

N69-11227# Case-Western Reserve Univ., Cleveland.

SEARCH FOR THE DISINTEGRATION OF DEUTERONS BY ELECTRON ANTINEUTRINOS

Jack Howard Munsee (Ph.D. Thesis) Sep. 1968 81 p refs Supported in part by AEC

(UCI-10-P-19-4) Avail: CFSTI

An attempt was made to measure the cross section for the disintegration of the deuteron by electron antineutrinos in order to comment on the validity of the neutral weak interaction current theory. This event could be recognized by the detection of both disintegration products, the neutron and the proton. The proton would be detected in a deuterated liquid scintillator which also serves as the target. The liquid scintillator was loaded with gadolinium whose neutron capture gammas were detected by two cylindrical NAI(Tl) crystals located on opposite sides of the liquid scintillator. The signature for the event would be a prompt proton pulse followed by a coincidence between the two crystals which signaled neutron capture. The crystal energy gates were set between 0.75 and 6.25 MeV and the liquid scintillator gates were set to see the light output equal to that produced by electrons of energies greater than 0.20 MeV and less than 0.59 MeV. Author (NSA)

N69-11229# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ASYMPTOTICS OF THE FEYNMAN GRAPHS

I. F. Ginzburg, A. V. Efremov, and V. G. Serbo 1968 10 p refs In RUSSIAN

(JINR-P2-3833) Avail: CFSTI

A method for extracting the asymptotics of any Feynman graph in the theory with $L = g\bar{\psi}\Gamma\psi\phi + h\phi^4$ ($\Gamma = 1$ or γ_5) is described. Author (NSA)

N69-11232# Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany).

PHASE SPACE COMPRESSION IN CIRCULAR ACCELERATORS AND STORAGE RINGS

J. Biersack Dec. 1967 46 p refs In GERMAN; ENGLISH summary

(HMI-B-55) Avail: CFSTI

A new derivation of the equations of motion is given for charged particles in the rf field of a circular accelerator. The cases, which yield nonhamiltonian equations of motion, are studied with respect to a compression of phase space. Such a possibility occurs if there exists an energy loss due to radiation or a radius-dependent rf voltage in addition to some energy loss (e.g., radiation) or gain (e.g., betatron field). It is shown that in the second condition the compression is much more significant than in the first. The effect on the examples of a betatron-synchrotron and of an electron storage ring is illustrated. The radial perturbation of the orbit, which is an inevitable side effect of the radius-dependent rf voltage, is examined. Author (NSA)

N69-11236# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

A LOWER BOUND OF THE ELASTIC SCATTERING AT FIXED MOMENTUM TRANSFER II

Varoujan Baluni and Nguyen Van Hieu 1968 5 p refs

(JINR-E2-3933) Avail: CFSTI

On the basis of axiomatic analyticity some lower bounds of the elastic scattering amplitudes for all finite momentum transfers are established. Author (NSA)

N69-11238# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

MEASUREMENT OF THE PHOTOPRODUCTION OF VERY ASYMMETRIC mu-PAIRS BY A RANGE ABSORBER METHOD

Eberhard von Goeler and Peter Joos Jun. 1968 47 p refs

(DESY-68/34) Avail: CFSTI

Some cross section calculations and other considerations for a possible measurement of very asymmetric muon pair production in carbon or hydrogen are presented. In this type of experiment only one member of the pair is observed. It carries off most of the photon energy and is emitted near the forward direction. A range absorber method for the detection of the muons is proposed. In this method a thick iron filter permits the passage of muons to a set of detectors. The energies of the muons are determined by their ranges in the material. Most other particles are absorbed by the iron filter before they reach the detectors. This experiment can be performed in the GeV range and will test quantum electrodynamics and/or muon electron symmetry with a sensitivity comparable to other pair production experiments. Author (NSA)

N69-11247# La Plata Univ. (Argentina).

MODEL CALCULATION OF COULOMB EFFECTS IN THE THREE-NUCLEON SYSTEM

Victor A. Alessandrini, Huner Fanchiotti, and Carlos A. Garcia 1967 40 p refs

(NP-17557) Avail: CFSTI

When two particles interact via a potential V which is the sum of a separable potential V_s and a Coulomb potential V_c, the two-body T-matrix can be obtained exactly and can be split in the usual way in a pure Coulomb T-matrix and a nuclear T-matrix which also contains Coulomb effects. Using the fact that the nuclear T-matrix is still separable in the off-shell variables, the Faddeev–Lovelace equations are applied to the calculation of Coulomb effects in the three-nucleon system, when the nuclear forces are described by separable interactions. The contribution of the nonseparable Coulomb T-matrix to the potentials that appear in the Faddeev–Lovelace equations is neglected, although it is known how to introduce it in a perturbative fashion. The Coulomb energy Δ_c of ^3He and the probability $P_{3/2}$ of finding the ^3He in a $I = 3/2$ state are calculated, using s-wave spin-dependent potentials of the Yamaguchi type to describe the two-nucleon interaction. This model yields values for Δ_c which are in reasonable agreement with the binding energy difference of ^3H and ^3He but predicts a negligible admixture of the $I = 3/2$ state in the ^3He wave function. Finally, the possible relevance of hard-core effects and the nonseparable Coulomb part of the p-p t-matrix is pointed out. Author (NSA)

N69-11261# Rochester Univ., N. Y. Nuclear Structure Research Lab.

ASSESSMENT OF EVIDENCE ON S-D SHELL NUCLEI

H. E. Gove Aug. 1968 28 p refs Presented at Gordon Conf. on Nucl. Struct., Tilton, N. H.

(UR-NSRL-7) Avail: Issuing Activity

Systematic properties of nuclei in the s-d shell are indicated, and certain individual nuclei are discussed. A strikingly similar variation of the energy of the 2+ first excited state in even-even nuclei is noted for $N = Z$ and $N = \pm Z$. Another correlation through the shell is the variation of M^2 for E3 transitions; and the low lying I=1 levels in pick up reactions like (p,d) and (d, He^3) are noted in the first half of the s-d shell. Recent findings are reviewed for Ne^{20} through Ne^{24}, Mg^{25}, Mg^{26}-Al^{25}, Mg^{26}-Al^{27}-Si^{28}, Si^{29} through Si^{32}-Cl^{37}-Ar^{38}, and K^{39}. M.W.R.

N69-11272# Illinois Univ., Urbana.

AN UPPER LIMIT ON THE DECAY RATE K_L YIELDS POSITIVE AND NEGATIVE PIONS PLUS GAMMA

R. C. Thatcher, A. Abashian, R. J. Abrams, D. W. Carpenter, R. E. Mischke et al 1968 18 p refs Presented at the 14th Intern. Conf. on High Energy Phys., Vienna

(COO-1195-129; CONF-680809-24) Avail: CFSTI

A search was made for the decay mode $K^0_L \rightarrow \pi^+\pi^-\gamma$. The charged decay products were momentum analyzed in a magnet and identified in a set of range-shower spark chambers. The position of the gamma ray conversion point in these chambers was compared with the position predicted on the hypothesis of $K^0_L \rightarrow \pi^+\pi^-\gamma$. The $K_{\pi 3}$ provided almost the sole background as well as the normalization of the rate measurement. In 982 events with good gamma showers, one event fitted the $\pi\pi\gamma$ hypothesis within the special resolution. However, the expected background

was one event. This result corresponds to an upper limit on the decay rate $R(K^0 \rightarrow \pi^+\pi^-\gamma) \leq 7.5 \times 10^3$ sec^{-1} at a confidence level of 90%. Author (NSA)

N69-11280# Cornell Univ., Ithaca, N. Y. Nuclear Reactor Lab.
EXPERIMENTAL STUDIES OF Ba-136m, Xe-134m, Xe-127m, AND Xe-125m
Willard Gary Winn (Ph.D. Thesis) Jun. 1968 166 p refs
(Contract AT(30-1)-3664)
(CURL-24; NYO-3664-6) Avail: CFSTI

The isomers ^{136m}Ba, ^{134m}Xe, ^{127m}Xe, and ^{125m}Xe were produced by pulsed neutron irradiation of enriched and natural samples in the Cornell TRIGA and transported by fast pneumatic transfer to a counting station where gamma and conversion electron spectra were observed using NaI(Tl), Ge(Li), and Si(Li) detectors. Because of the short half-lives of the isomers investigated, special techniques were devised to provide fast positioning of the sample for detection. $^{136m}Ba(T_{1/2} = 307 \pm 4$ msec) and $^{134m}Xe(T_{1/2} = 290 \pm 17$ msec) were studied with reference to analogous isomers in the N = 80 isotones. Each isomer decays by a three gamma cascade. Corresponding gamma energies are 168 ± 7, 1048.6 ± 0.7 and 819.3 ± 0.7 keV in ^{136m}Ba; and 232.9 ± 1.5, 879.9 ± 1.4, and 845.9 ± 1.0 keV in ^{134m}Xe. As the isomer ^{134m}Xe had not been observed previously, internal conversion studies were performed to establish the multipolarity of the isomeric transition. Author (NSA)

N69-11284# Oak Ridge National Lab., Tenn.
REVISED NEUTRON KERMA VALUES AT THE BOUNDARY OF A SEMI-INFINITE CONCRETE MEDIUM
F. A. R. Schmidt (Stuttgart Univ.) 10 Jul. 1968 17 p refs
(Contract W-7405-ENG-25)
(ORNL-TM-2284) Avail: CFSTI

The values of the kerma at the boundary of a semi-infinite concrete medium for several incident neutron energies have been estimated from published albedo values. These values have been used to revise the data of Clark, Betz, and Brown which give kerma as a function of concrete thickness. Author (NSA)

N69-11288# Rochester Univ., N. Y. Nuclear Structure Research Lab.
NUCLEAR STRUCTURE RESEARCH LABORATORY Annual Progress Report, Nov. 1966–Nov. 1967
Jan. 1968 81 p refs Supported in part by AEC and NSF
(UR-NSRL-PR1) Avail: Issuing Activity

Experiments were carried out on a variety of nuclear reactions, for which relative spectroscopic factors were determined, and studies were made of the reorientation effect in Ni^{60}, proton proton bremmstrahlung at 20 MeV, positive pion lifetime, absorption of stopped negative pions, and pion double charge exchange. Other experimental investigations deal with the two body spectrum of Sc^{42}, isospin selection rules, indirect excitations in stripping on heavy deformed nuclei, and coulomb excitation of the octupole multiplet in Bi^{209}. Small angle scattering of heavy ions, resonance fluorescence, a spark counter system, and a shell model program were also investigated. Installation of the MP tandem and efforts relating to the beam transport system, quadrupole design, support piers, ion sources, radiation monitoring and interlock system, and nuclear track plates are reviewed. The particle-gamma coincidence chamber, 21" scattering chamber for solid state detectors, counter development and production, and the computer system efforts are summarized. M.W.R.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N69-10023 State Univ. of Iowa, Iowa City.
RADIATION FROM AN OSCILLATING MAGNETIC DIPOLE IN A STREAMING PLASMA
John Emlin Bergeson (Ph.D. Thesis) 1967 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 67-16776

The electromagnetic field of an oscillating magnetic dipole is calculated, assuming that the dipole is immersed in a cold streaming plasma. The amplitude of the magnetic dipole moment, assumed known, is taken to be sufficiently weak that the linearized cold plasma equations may be used to describe the response of the plasma. The resulting field of the dipole is rather different from the field that would result if the plasma were not streaming. In particular, a longitudinal electrostatic field appears as a consequence of the plasma's motion. The far field of the dipole is such that the Poynting vector is not purely radial, but is tilted against the direction of the zeroth order plasma flow. The force necessary to hold the dipole in place vanishes when the dipole axis is parallel to the streaming direction, as does the longitudinal electric field. Dissert. Abstr.

N69-10034 Texas Technological Coll., Lubbock.
EFFECT OF PRESSURE HYDROCARBON EMISSION SPECTRA IN AN INDUCTION-COUPLED PLASMA
Carlton Tyrus Wendel (Ph.D. Thesis) 1967 84 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-2628

An induction-coupled plasma generator was used to decompose and excite carbon monoxide, methane, ethyl alcohol, and propane. The pressure effects on the species which emit radiation were studied extensively at pressures of 3, 10, 40, 60, and 680 mm mercury. Radiation was observed due to the species and band systems N_2 Second Positive, C_2 Swan, C_2 Deslandres-d'Azambuja, CO Third Positive, CO 5B, CO Angstrom, OH, CH, NH, CN Violet, CN Red, and CN Violet Tail Bands. The change in emitting species, from CO at 3 mm pressure to C_2 at 680 mm, was observed for all compounds studied. CO radiation disappeared between 90 and 100 mm pressure in carbon monoxide, between 60 and 70 mm pressure in ethyl alcohol, between 40 and 60 mm pressure in propane, and between 3 and 10 mm pressure in methane. C_2 radiation appeared at 3 mm pressure in methane, at 10 mm pressure in propane, at 30 mm pressure in ethyl alcohol, and at 40 mm in carbon monoxide. Dissert. Abstr.

N69-10097 California Univ., Berkeley.
THE NEGATIVE POINT TO PLANE BREAKDOWN IN A FREE ELECTRON GAS
Abbass Mohd. Hassoun (Ph.D. Thesis) 1967 43 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-75

Using an outgassed W point cathode in a 4-cm point-to-plane gap in pure He admitted under Alpert vacuum techniques, the breakdown was studied from 50 to 220 Torr as a function of steady potentials from appropriate capacities. The potential range was limited by the minimum measurable luminosity and by the danger of point damage above currents leading to hot cathode arc. Currents ranged from 10^{-4} A to amperes at peak. By appropriate electronic techniques with a dual-beam oscilloscope, current–potential, current–photomultiplier traces of luminous phenomena that crossed a slit transverse to the arc at various points in the gap, and potential–photomultiplier traces were observed as a function of time. The traces were observed with full luminosity as well as through two filters which distinguished field-conditioned excitation and thermal excitation. Dissert. Abstr.

N69-10102 California Univ., San Diego.
PROPAGATION AND REFLECTION OF THE LOSS-CONE MODE IN AN INHOMOGENEOUS PLASMA

Claude Wendell Horton, Jr. (Ph.D. Thesis) 1967 103 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-806

The dispersion relation for the loss-cone mode of Post and Rosenbluth is reviewed, and the physical characteristics of the mode are discussed. The dispersion relation is then solved for the growth length of the instability including the effects of finite electron temperature. A critical length for the confinement of the plasma is calculated by assuming that the waves are completely absorbed at the ends of the mirror machine. The propagation and reflection of the electron plasma wave which forms the basis of the loss-cone mode is considered in an inhomogeneous plasma by means of the Wentzel-Kramers-Brillouin method. The plasma wave functions are obtained to the first order in the WKB expansion parameter. The reflected wave is derived from the second order terms in the WKB expansion, and the reflection coefficient is given. From the reflection coefficient two physical processes for the reflection of plasma waves are identified. Dissert. Abstr.

N69-10123 Virginia Polytechnic Inst., Blacksburg.
THE ELECTRICAL AND THERMAL CONDUCTIVITIES OF A FULLY-IONIZED GAS
Clifford Lynn Fricke (Ph.D. Thesis) 1967 68 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-2045

This paper calculates the thermal and electrical conductivities based on the Balescu equation, taking into account both electron-electron and electron-proton interactions, but neglecting the small effects due to the motion of the protons. Starting with the Balescu kinetic equation, linearization is obtained by assuming that either a small electric field or a small temperature gradient exists in the plasma. The Chapman-Enskog perturbation method, along with the steady-state hydrodynamic approximation that a local equilibrium is set up with spatial variations existing only in number density and temperature, is used to obtain the first-order equation in the unknown electron distribution function. This equation is reduced to an integral-differential equation in a single scalar function F of the absolute velocity, by the usual assumption that the distribution function is proportional to the product of F times the Maxwellian distribution times the cosine of the angle between the particle velocity and the direction of the applied gradient. Dissert. Abstr.

N69-10134 Minnesota Univ., Minneapolis.
AFTERGLOW STUDIES IN NITROGEN
Roger Edward Lund (Ph.D. Thesis) 1967 192 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-1548

The present study is concerned with the temporal behavior of the $N+$, N_2+, N_3+, and N_4+ ions in nitrogen as well as with that of the afterglow light intensity in the pressure range of about 0.1 Torr to 1.7 Torr. The effect of different pulse lengths was also investigated. The nitrogen afterglow studies presented were performed through the use of the time sampling technique applied to light intensity and ion density measuring apparatus. The afterglow was produced by periodic rf pulses in a glass tube coated with a molybdenum film. An electric quadrupole mass spectrometer was used for ion mass identification while a light spectrometer allowed a determination of the spectral distribution. The analysis of the light intensity decay curves revealed that nitrogen atoms are not always destroyed upon collision with the wall. Evidence was obtained for an afterglow electron heating mechanism involving electrons and vibrationally excited ground state molecules. Dissert. Abstr.

N69-10138 Stevens Inst. of Tech., Hoboken, N. J.
CROSS-FIELD DIFFUSION OF QUIESCENT POTASSIUM MAGNETOPLASMAS
Neil Stephen Wolf (Ph.D. Thesis) 1967 92 p
Avail: Univ. Microfilms: HC $4.80/Microfilms $3.00 Order No. 68-1166

Measurements of the diffusion coefficient of a highly ionized, isothermal plasma across a confining magnetic field have been made with a new type of probe in a plasma generated by surface ionization of potassium vapor. The probe consists of a grid (which serves as one endplate of the plasma column) behind which is located a planar ion collecting electrode. This probe structure is moved along the axis of the plasma column and the current collected by the electrode as a function of grid probe to ionizing surface distance is related to the perpendicular diffusion coefficient. The results, for operation in a quiescent mode, show good quantitative agreement with the diffusion coefficient derived for binary electron–ion collisions in a fully ionized plasma. Dissert. Abstr.

N69-10139 Wisconsin Univ., Madison.
THE MOTION OF AN ELECTRIC ARC IN THE TRANSVERSE MAGNETIC FIELD
Warren Robert Hingst (Ph.D. Thesis) 1967 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-12432

Described are experiments conducted to evaluate the interaction of an electric arc with a transverse magnetic field. The experimental apparatus consisted of circular ring shaped electrodes with an externally applied radial magnetic field. All experiments were conducted in an argon atmosphere. The interaction of the electric arc with the transverse magnetic field produces a Lorentz force acting in the azimuthal direction; this force drives the arc along the circular electrodes. This electrode–magnetic field arrangement allows continuous operation of the arc experiment. The repeated passage of the arc over the electrodes insures a rapid approach to stabilized and uniform electrode surface conditions which are known to have an important bearing on moving arc behavior. The differences between moving and stationary arcs are discussed with emphasis on the influence of electrode surface phenomena. Dissert. Abstr.

N69-10150 Minnesota Univ., Minneapolis.
A STUDY OF THE MOBILITY OF IONS PRODUCED IN RARE GAS PLASMAS
James Merle Madson (Ph.D. Thesis) 1967 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-1550

Ion mobility is measured by the transit-time method. The ions are mass identified by a quadrupole mass spectrometer. The drift tube and the mass spectrometer section are separated by a copper diaphragm containing a centrally located 100 micron aperture. The ions to be studied are extracted from a dc discharge and accelerated into a pre-drift region which is maintained at the same E/p_0 ratio as the drift region. The drift tube is operated as a double shutter tube. The first shutter is located at the entrance to the drift region and the second at the entrance to the mass spectrometer. A pulse of ions (1 μ sec) is gated into the drift region through a co-planar alternating grid. Some of the ions which cross the drift region under the influence of a uniform electric field pass through the aperture and into the region of the entrance grid to the mass spectrometer. The discharge and gating assembly in the drift tube is movable to permit measurements at different drift distances. The drift velocities are calculated using the differential distances and transit times from two measurements. Results obtained in helium for the mobility of the atomic helium ion are consistent with previously reported values. Dissert. Abstr.

N69-10152 Rochester Univ., N. Y.
SCREW INSTABILITY OF A THERMALLY INHOMOGENEOUS POSITIVE COLUMN IN A LONGITUDINAL MAGNETIC FIELD

Chul Mo Kim (Ph.D. Thesis) 1967 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 67-13629

A study designed to (1) examine the effects of thermal inhomogeneity and associated density distributions on the screw instability in a positive column and (2) establish the domain of parameters for which quasineutrality is a valid simplification in the analysis of the instability; is reported. Using the parabolic temperature distribution obtained by Ecker and Zöller and density distributions deviating in various ways from the zeroth-order Bessel function J_0, the curves of the onset of instability for several temperature and density gradients are calculated. It is found that the electric field needed to maintain the discharge in the thermally inhomogeneous case is reduced approximately by the ratio of the ion-neutral temperature at the axis to that at the wall, compared with the electric field in the thermally homogeneous case. As a result, the critical magnetic field reached is larger for the thermally inhomogeneous case than for the thermally homogeneous case. Thermal inhomogeneity is thus found to have a stabilizing influence on screw instability. By perturbing the densities of ions and electrons independently and using the perturbed potential derived by Matsumoto, the domain of parameters for which quasineutrality is a valid simplification was obtained. The assumption of quasineutrality was found to introduce less than 1% error, provided the charged particle density was greater than $10^{10}/cm^3$ for the dimensionless wave number, kR, less than 1.2. In addition, the dependence of the stability curves upon the two parameters, the ratio of ion-neutral to electron temperature and the charged particle density, is examined. Dissert. Abstr.

N69-10243 Illinois Univ., Urbana.
INCOHERENT SCATTERING OF MICROWAVES FROM ENHANCED DENSITY FLUCTUATIONS IN A DC-DISCHARGE
Wayne Elbert Carr (Ph.D. Thesis) 1967 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-1719

Radiation of 9375 MHz is incident on a cylindrical neon discharge enclosed in a 1" square waveguide and incoherent scattering in the upper sideband is investigated. Scattering is observed in the backward and forward directions from the naturally enhanced density fluctuations in two electron plasma modes for gas pressures between 3.8×10^{-3} Torr and 8.0×10^{-3} Torr. The measured electron mode frequencies are in general agreement with other experiments. The enhancement, varying between 30 and 8000 times the estimated thermal value is correlated over most of the pressure range to excess superthermal electrons present in the discharge, as measured by a Langmuir probe. Dissert. Abstr.

N69-10270 Catholic Univ. of America, Washington, D. C.
STRUCTURES OF MAGNETO-HYDRODYNAMIC SHOCK WAVE
Chung Kuang Liu (Ph.D. Thesis) 1967 72 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 67-17154

This dissertation studies the structure of the plane magneto-hydrodynamic shock wave of a rarefied, fully-ionized plasma. Both the shock front and the magnetic field are assumed to be perpendicular to the flow direction. In the undisturbed region, the gas pressure can be comparable to, much smaller or much larger than the magnetic pressure, and also the magnetohydrodynamic Mach number (M^*) can be any value greater than unity. Since the plasma is so rarefied that the mean free path here can not be considered as a relevant scale length for the shock thickness, instead the geometrical mean of the ion and electron Larmor radius is the appropriate one. Under these assumptions, the structure of larger M^* shock wave is solitary wave-like, and that of smaller M^* shockwave can be either oscillatory or monotonic depending on the value of electrical resistivity. Dissert. Abstr.

N69-10329 State Univ. of Iowa, Iowa City.
SECULAR EFFECTS AS RELATED TO THE NONLINEAR BEHAVIOR OF PLASMAS
Robert Edward Mc Intosh, Jr. (Ph.D. Thesis) 1967 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-956

The problem of plasma nonlinearities is treated in this thesis both theoretically and experimentally. This treatment includes the nonlinear behavior which results when the plasma is in the presence of a strong external time varying electromagnetic field. Certain nonlinear phenomena are predicted when a modified form of Duffing's equation is used to model the longitudinal electric field in a plasma. By using a multiple time scale perturbation method, harmonic and subharmonic oscillations and frequency shifts are calculated which agree well with experiment. Five experiments are described in this thesis. Dissert. Abstr.

N69-10441# Cekmece Nuclear Research Center, Istanbul (Turkey).
UNIFIED TRANSPORT THEORY OF TWO-TEMPERATURE FULLY IONIZED PLASMAS
Umur Daybelge Jul. 1968 23 p refs
(CNAEM-59) Avail: Issuing Activity

The transport coefficients of a nonisothermal, fully ionized plasma have been determined without any cut-off procedure. The theory is exact in the sense that it is valid not only for large values of the Coulomb logarithms themselves but also for large values of their arguments. The effect of interactions between electrons and plasma oscillations has been incorporated in the theory. External magnetic fields have not been considered. Author

N69-10451*# Harvard Univ., Cambridge, Mass. Gordon McKay Lab.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF ANTENNAS AND WAVES IN PLASMA Semiannual Status Report, 1 Mar.–31 Aug. 1968
Ronald W. P. King 22 Oct. 1968 6 p refs
(Grant NGR-22-007-056)
(NASA-CR-97570) Avail: CFSTI CSCL 20I

Parametric interactions were studied in a dielectric medium space-time modulated by two pump waves, and experimental investigations were made of the impedance behavior of a short, cylindrical probe in a magnetoplasma. A cylindrical dipole antenna immersed in a warm homogeneous and isotropic plasma, and driven at the center by a delta-function generator, was treated as a boundary value problem. Mention is made of other studies related to antennas and waves in plasmas. M.W.R.

N69-10471*# National Aeronautics and Space Administration, Langley Research Center, Langley Station Va.
COMPUTER EXPERIMENTS ON THE MICROSCOPIC BEHAVIOR OF ONE-DIMENSIONAL PLASMAS
Richard H. Weinstein and Belinda H. Adams Washington Nov. 1968 59 p refs
(NASA-TN-D-4831) Avail: CFSTI CSCL 20I

The detailed motions of a system of 1000 particles simulating a one dimensional electrostatic plasma have been followed by using the IBM 7040/7094 Direct Coupled System at the Langley Research Center. The particle interactions are collective and as the calculation proceeds stepwise through time, the position-velocity histories of all the particles completely specify the successive states of the system. These data constitute an experiment, upon which measurements can be made. The velocity distribution function, the Fourier harmonics of the potential energy, the spatial correlations of the electric field, and the drag and velocity diffusion of test particles are measured for the Maxwellian and uniform velocity distributions. Comparison of the present work with both earlier experiments and the predictions of zeroeth and first-order plasma kinetic theory have yielded generally good agreement for all

measurements in both equilibrium and nonequilibrium plasmas. The detailed behavior of the long wavelength harmonics of the potential energy is, however, unresolved for regions where the assumptions of the zeroeth-order theory are not satisfied. Author

N69-10475# Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland).
LUMPED ELEMENT LINE GENERATORS TO PRODUCE PULSED SINUSOIDAL OSCILLATIONS IN THE GIGAWATT RANGE
A. Lietti May 1968 37 p
(LRP-37/68) Avail: Issuing Activity

The present state of knowledge concerning the technique of making high power sinusoidal pulses is reviewed and an improved line generator proposed. An analysis of wave propagation in a periodic structure together with the numerical solution of the network differential equations shows that it is possible to utilize the recurrent triggering system (hitherto applied only to homogeneous lines) with lumped element lines. A method for designing such lines is presented. Numerical tables are included and some selected examples are discussed. The theory agrees with an experiment made with a prototype line. The construction of a 720-MW, 3 MHz installation for use in plasma physics experiments is already underway. This large power is achieved by paralleling a number of lumped element line generators. Author (NSA)

N69-10479# Academy of Sciences (USSR), Leningrad.
THE PLASMA-ELECTRON CONFINEMENT REGION FOR ELECTRON-CYCLOTRON RESONANCE IN A MAGNETIC TRAP WITH PLUGS
B. V. Galaktionov, V. V. D'Yachenko, K. M. Novik, and A. D. Piliya 1968 9 p refs In RUSSIAN
(NP-17565) Avail: Issuing Activity

It has been shown theoretically that when plasma is heated by an ultrahigh frequency field under conditions of electron cyclotron heating in a trap with plugs, all of the electrons are reflected from the magnetic plugs in the same plane, in which the ultrahigh frequency power is also absorbed. It was attempted to determine experimentally the region of reflection of the plasma, using two devices with open traps, with a plug similar to the configuration of the magnetic field; the ultrahigh frequency power was conducted to the plasma by means of a waveguide. At the maximum of the magnetic field a single 4 μsec uhf pulse was sent into the plasma by the 20 kW, 9350 MHz generator. The concentration of the plasma was measured by means of a microwave interferometer. The results confirmed the authors' previous findings, indicating that there is a narrow region near the resonance value of the magnetic field, in which the charged particles are reflected. NSA

N69-10480# Academy of Sciences (USSR), Moscow.
PLASMA INSTABILITY IN A NONHOMOGENEOUS ULTRAHIGH-FREQUENCY FIELD
G. M. Batanov, K. A. Sarkisyan, and V. A. Silin 1968 31 p refs In RUSSIAN
(NP-17559) Avail: Issuing Activity

Studies were made of a plasma jet moving along a homogeneous magnetic field, crossing a circular waveguide, and colliding in the waveguide with an excited, traveling-wave ultrahigh-frequency field. It is shown that inclusion of the TE_{11} wave in the plasma-generated electron beam and induced turbulence in the charded-particle density along the plasma jet cross section resulted in plasma losses on chamber walls all along the length of the flow. In the case in which the wave became excited before the plasma front arrived, the plasma remained stable. The mechanism of plasma instability was analyzed. Author (NSA)

N69-10486# Academy of Sciences (USSR), Leningrad.
STUDIES OF PLASMA PINCH BY REFLECTION OF ULTRAHIGH FREQUENCY WAVES
V. A. Ipatov, M. G. Kaganskii, S. G. Kalmykov, and V. A. Ovsyannikov 1967 14 p refs In RUSSIAN
(NP-17570) Avail: Issuing Activity

External magnetic field plasma pinch was studied using plasma localization by ultrahigh frequency wave reflection (microwave diagnostics). Measurements were made of 4- and 8-mm long waves. Observations on the Tuman installation revealed a rapid drop in plasma concentration near the diaphragm during plasma compression. The radius of the plasma cylinder with concentration exceeding 1.7×10^{13} cm^{-3} reduced 3 cm during compression (the diaphragm radius was 6 cm). The drift velocity of critical concentration plasma layers exceeded 2 to 3 times the velocity calculated for conditions with a frozen-in magnetic field. Author (NSA)

N69-10522 Aix-Marseilles Univ. (France). Institut de Mechanique des Fluides.
STUDY OF THE INTERACTION OF A MAGNETIC FIELD AND A FLOWING IONIZED GAS. STUDY OF THE PHYSICAL PROPERTIES OF PLASMA AND ITS AERODYNAMIC BEHAVIOR [ETUDE DE L'INTERACTION D'UN CHAMP MAGNETIQUE ET D'UN GAZ IONISE EN ECOULEMENT. ETUDE DES PROPRIETES PHYSIQUES DU PLASMA ET DE SON COMPORTEMENT AERODYNAMIQUE]
P. Parraud, B. Forestier, and B. Fontaine [1967] 71 p refs In FRENCH
(Contract DRME-67-34-014-00-480-75-01)
Avail: CFSTI

An experiment is presented for producing flows of very high energies to simulate flight reentry conditions of artificial satellites using the principle of plasma acceleration by crossed fields. The experimental parameters of the induced plasma flow at Mach 2 through an accelerating exhaust tube with nine electrode stages are described. The theory is studied for an interaction which takes place between a one dimenional, stationary, non viscous perfect gas flow situated between two equipotential electrodes and constant magnetic and electric fields. Direct measurements of the electron density of the plasma are made for nonequilibrium, ionization conditions. An ionic pulse laser was constructed and calibrated for the optical study of rapidly evolving plasmas. Transl. by B.P.

N69-10587# Joint Publications Research Service, Washington, D. C.
NINE PLUS ONE: A NEW DISCOVERY IN PLASMA PHYSICS
P. Yur'yev 22 Oct. 1968 3 p Transl. into ENGLISH from Znaniye-sila (Moscow), no. 6, 1968 p 30–31
(JPRS-46727) Avail: CFSTI

The nonlinear effect of the formation of a self-sustaining high temperature electrically conductive layer (T-layer) in a compressible medium in a magnetic field is discussed. Consideration is given to the nature of a plasma, a magnetohydrodynamic generator, and the T-layer which was discovered during numerical experiments related to plasmas. This high temperature formation is considered to exist because of the dissipative processes of electrical conductivity; and because of the electromagnetic field and heat conversion, this T-layer maintains its structure in plasma. M.W.R.

N69-10614# Princeton Univ., N. J. Plasma Physics Lab.
FINITE ION LARMOR RADIUS AND ION-ION COLLISION EFFECTS ON EQUILIBRIUM, CRITICAL FLUCTUATION, AND DRIFT-WAVE STATES OF ALKALI-METAL PLASMA

T. K. Chu, H. W. Hendel, R. W. Motley, F. Perkins, P. A. Politzer et al Jul 1968 21 p refs Presented at the 3d Intern. Conf. on Controlled and Plasma Phys., Novosibirsk, USSR, 1–7 Aug. 1968
(Contract AT(30-1)-1238)
(MATT-619; CONF-680805-14) Avail: CFSTI

Recent experiments and theories show that the effects of finite Larmor radius and ion–ion collisions, i.e., ion transverse viscosity, play a major role in determining the equilibrium state, and the linear stabilization and nonlinear amplitude saturation of the collisional drift wave state in alkali metal plasmas. Author (NSA)

N69-10617# Polish Academy of Sciences, Warsaw.
SPECTROSCOPIC MEASUREMENTS OF TEMPERATURE IN INDUCTION PLASMA TORCH [SPEKTRALNE POMIARY TEMPERATURY PLAZMY W PLAZMOTRONIE INDUKCYJNYM]
J. Lesinski, B. Lewandowski, and S. Suckewer 1968 16 p refs In POLISH; ENGLISH summary
(INR-906) Avail: Issuing Activity

Results of the studies are described on temperature and electron density distribution in an induction argon plasma torch. Nominal output of the supplying RF generator amounted to 10 kW and its frequency–3 MHz. The temperature of plasma was determined from the absolute intensity of argon atomic lines and from the absolute intensity of continuum radiation. Detailed description of both methods is given. The maximum temperature obtained in the axis of plasma column was 10,350°K and electron density 3.5×10^{17} cm^{-3}. Author (NSA)

N69-10624*# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
TRAPPED WAVES PROPAGATING ALONG A WARM PLASMA SLAB
J. D. Mitchell 15 Sep. 1968 67 p refs
(Grant NsG-134-61)
(NASA-CR-97614; SR-324) Avail: CFSTI CSCL 20I

Trapped modes in a warm plasma slab partially filling a parallel plate waveguide are studied. A two fluid model with a scalar pressure term for electrons is used to obtain the field solutions and dispersion equations for both a symmetric and antisymmetric longitudinal $\bar{E}$ field. The dependence of the dispersion relations on electron temperature, slab thickness, and waveguide width is studied. The quasistatic dispersion equation and a dispersion relation obtained by a heuristic argument are compared with the more rigorous dispersion relation and the regions of validity are discussed. Good agreement is found between experimental data measured in a cylindrical system and the theoretical results of the slab geometry. Finally, the effects of Landau damping and electron-neutral collisional damping are considered. Author

N69-10625# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Institut.
INVESTIGATION OF HEATING OF PLASMA BY FAST, LARGE-AMPLITUDE, MAGNETOSONIC WAVE
M. P. Vasil'ev, L. I. Grigor'eva, A. V. Longinov, B. I. Smerdov, and V. V. Chechkin 1968 18 p refs In RUSSIAN
(NP-17551) Avail: CFSTI

Under study is the resonant excitation and absorption of fast magnetosonic waves in hydrogen plasma within a frequency range of $\omega_i \leq << \sqrt{\omega_i \omega_e}$ (ω_i,ω_e are, respectively, the cyclotronic frequencies of the ions and electrons and ω is the frequency of the wave) with the plasma having a density of 10^{13} to 10^{14} cm^{-3}. The variable field in the plasma was generated by a coil consisting of several sections connected in pairs and in antiphase. The coil served as an inductance of the impact circuit with a reserved energy of up to 10 joules and a frequency of 7×10^6 cycles. During the resonant excitation by a fast magnetosonic wave, the plasma received up to 70% of the energy stored in the circuit. At this, the amplitude of the variable magnetic field in the plasma reached an amplitude of 500 oersteds. There took place a fast (> 1 μsec) heating of electrons to an average energy of ≈ 200 eV and of the ions to ≈ 20 eV. NSA

N69-10632# Academy of Sciences (USSR), Moscow. Physics Inst.
THE THEORY OF EQUILIBRIUM AND STABILITY OF STRONG CURRENT DISCHARGE IN A DENSE OPTICALLY TRANSPARENT PLASMA, 2
V. B. Rozanov, A. A. Rukhadze, and S. A. Trigor 1968 18 p refs In RUSSIAN *Its* Preprint No. 11
(NP-17573) Avail: CFSTI

Equilibrium and stability of a strong-point discharge in a dense optically transparent plasma are studied. It is shown that, in contrast to the optically nontransparent plasma, the temperature of a transparent discharge changes on the same scale as other hydrodynamic magnitudes. Small-oscillation spectral analysis revealed that, within the limits of geometrical optics approximation, the discharge was unstable. Discharge stability was studied considering mainly bremsstrahlung. However, some data were obtained on the instability produced by other types of radiation. Author (NSA)

N69-10651*# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
A BIASED ELECTROSTATIC PROBE IN A CONTINUUM REGIME
Samuel Lederman and Yoel Avidor Aug. 1968 32 p refs
(Grant NsG-409)
(NASA-CR-97579; PIBAL-68-28) Avail: CFSTI CSCL 20I

The current collection of cylindrical negatively biased electrostatic probes in a continuum plasma regime is experimentally investigated. The effects of plasma flow, length-to-diameter ratio, diameter, and angle of attack of the probes with respect to the moving plasma are found to be rather strong. It is found that the current collection of the probe increases with the angle of attack, with the decrease of the fineness ratio l/R_p and with the decrease of the diameter of the probe. Author

N69-10671# Polish Academy of Sciences, Warsaw.
RESEARCH ON PRODUCTION AND CONTAINMENT OF PLASMA IN A SPHERICAL MULTIPOLE MAGNETIC FIELD. 3. RESULTS OF EXPERIMENTAL STUDIES [BADANIA NAD WYTWARZANIEM I OGRANICZANIEM PLAZMY W UKLADZIE SFERYCZNEGO MULTIPOLA MAGNETYCZNEGO. 3. WYNIKI BADAN EKSPERYMENTALNYCH]
Marek Sadowski 1968 46 p refs In POLISH; ENGLISH summary
(INR-914) Avail: Issuing Activity

The results are presented of experimental research on the production and containment of hot plasma in a spherical multipole magnetic field. Investigations of the synchronous operation of 6 fast gas valves and 6 plasma injectors are described. The lifetime of the plasma is assessed on the basis of integral visible radiation. For comparison with the above lifetime, measurements performed in the conventional cusped geometry, and in a hybrid SM trap with an additional mirror field are described. Results of probe measurements of the plasma lifetime in the traps investigated are given. The investigations referred to prove that the plasma lifetime in the SM-type trap (under conditions of the experiment 85 μsec) is approximately 3 times that in the cusp configuration, with the other experimental conditions identical. Author (NSA)

N69-10678# Los Alamos Scientific Lab., N. Mex.
MONTE CARLO AND COMPUTER PLASMA SIMULATION STUDIES OF THE INHIBITION OF END LOSS FROM A θ-PINCH BY NONADIABATIC "ROUGH" MAGNETIC WALLS

James L. Tuck. [1968] 12 p refs Presented at 3d Intern. Conf. on Controlled and Plasma Phys., Novosibirsk, USSR
(Contract W-7405-ENG-36)
(LA-DC-9328; CN-24/K-5; CONF-680805-11) Avail: CFSTI

Monte Carlo studies of particles escaping from a $\beta = 1$ θ pinch, having a sharp plasma field boundary equipped with multiple small perturbations have indicated that cumulative nonadiabatic effects can be promoted. The plasma model studied was too simple to be valid for a real plasma; plasma loss reductions which resulted were surprisingly large. Using a previously developed computer simulated θ-pinch plasma model with appropriately modified magnetic field, 13,000 particles are followed at high β, the magnetic field being computed self-consistently. Electrons are assumed to maintain space charge neutrality at all points. The systems studied so far, with their losses at two-thirds characteristic time are: open ended θ-pinch (smooth walls) (4000); open ended θ-pinch (smooth walls) plus mirror (3400); open ended θ-pinch (rough walls) (stationary) (2800); and open ended θ-pinch (rough walls) (moving) (2400). Adequate description of the plasma distribution in the radial direction required 20 steps; the longitudinal steps numbered 100. Author (NSA)

N69-10697# Princeton Univ., N. J. Plasma Physics Lab.
SOME INVESTIGATIONS OF NONLINEAR PLASMA BEHAVIOR ON ONE-DIMENSIONAL PLASMA MODELS
J. M. Dawson, C. G. Hsi, and R. Shanny Jul. 1968 24 p refs Presented at 3d Intern. Conf. on Controlled and Plasma Phys., Novosibirsk, USSR, 1–7 Aug. 1968
(Contract AT(30-1)-1238)
(MATT-623; CONF-680805-15) Avail: CFSTI

Earlier calculations on the two-stream instability using the sheet model are extended. Vortexes in phase space similar to those found by Roberts and Berk are found. A new finite-size particle model is developed to reduce collisional effects. This model suppresses the short wavelength field fluctuations while leaving the long wavelength collective modes unaffected. The turbulence generated by a small bump in the tail of the distribution function is investigated on this model. It is found here, as in the sheet model calculations, that a hot Maxwellian tail is formed which coexists with the main plasma for a very long time. Author (NSA)

N69-10699# Princeton Univ., N. J. Plasma Physics Lab.
EXPERIMENTAL STUDIES OF ANOMALOUS RESISTIVITY AND THE ASSOCIATION OF FLUCTUATIONS AND COLLISION FREQUENCY WITH CONFINEMENT
I. G. Brown, D. L. Dimock, E. Mazzucato, K. M. Young, R. M. Sinclair et al Jul. 1968 17 p refs Presented at 3d Intern. Conf. on Controlled and Plasma Phys., Novosibirsk, USSR, 1–7 Aug. 1968
(Contract AT(30-1)-1238)
(MATT-621; CONF-680805-12) Avail: CFSTI

Experiments were directed toward elucidation of the anomalous plasma loss in the C stellarator. The experiments all make use of ohmic heating to form the plasma, but one finds that the detailed properties observed depend markedly on the ratio of the current drift velocity to the particle thermal velocities. As u_e/v_i becomes greater than unity with ohmic heating, the plasmas become collisionless in the sense that $\lambda_e \geq L$. Alternatively, the collisionless regime has been attained by Landau damping of ion cyclotron waves by the electrons with $u_e/v_i < 1$. Author (NSA)

N69-10701# Princeton Univ., N. J. Plasma Physics Lab.
EFFECT OF SHEAR AND CONNECTION LENGTH ON DRIFT WAVES AND PLASMA CONFINEMENT
F. F. Chen, D. Mosher, and K. C. Rogers Jul. 1968 20 p refs Presented at 3d Intern. Conf. on Controlled and Plasma Phys., Novosibirsk, USSR, 1–7 Aug. 1968
(Contract AT(30-1)-1238)
(MATT-625; CONF-680805-13) Avail: CFSTI

The effectiveness of shear and of short connection length on drift instabilities in a 0.22-eV thermally ionized, 3-meter-long potassium plasma was investigated. These experiments were carried out with T_i/T_e and ρ_i/R in a regime comparable to what would obtain in a fusion reactor. In the density range $n = 10^9$ to 10^{11} cm^{-3}, the transition from collisionless to collisional excitation of drift waves is covered; ion viscosity is important only at highest densities studied. By tailoring the radial electric field, it is possible to produce quiescence, turbulence, or single modes. Shear is applied by passing current through a 1-cm-diam. hard core along the axis. Both turbulent and coherent drift waves are stabilized by shear of order $\theta \approx 0.05$, in fair agreement with the theory of Krall and Rosenbluth. However, at large shear, small-amplitude coherent oscillations reappear unexpectedly. At zero shear, $D_\perp$ is 2 to 3 times the Bohm diffusion coefficient; at maximum shear, $D_\perp$ is decreased a factor of 5 to 30 to 2 to 3 times the classical value. Author (NSA)

N69-10702# Princeton Univ., N. J. Plasma Physics Lab.
LOW-FREQUENCY PLASMA LOSS MECHANISMS IN MHD-STABILIZED TORUSES
H. P. Furth and M. N. Rosenbluth Jul. 1968 30 p refs Presented at 3d Intern. Conf. on Controlled and Plasma Phys., Novosibirsk, USSR, 1–7 Aug. 1968
(Contract AT(30-1)-1238)
(MATT-624; CONF-680805-16) Avail: CFSTI

Anomalous plasma losses can occur even in the absence of apparent fluctuations, through the mechanism of large single-particle excursions in spatially irregular quasistatic magnetic and electric fields. The conservation of the second adiabatic invariant J provides the basis for a general analysis of these low-frequency mechanisms. The effect on particle excursions of irregular electrostatic potentials is investigated and in the limit of small gyroradii and strong shear is found to be comparable to the effect of nonsymmetric (stellarator) geometry. Magnetic trapping of particles lends itself to self-consistent irregular potentials (convective cells); while electrostatic trapping leads to a stable drift mode, and to the possibility of convective cells. Shearless magnetic wells (multipoles), are unstable against growth of MHD convective cells. For small plasma potentials, however, the instability goes to short wavelength where the MHD approximation breaks down. Small gyroradii and deep magnetic wells are found to be favorable to the suppression of particle convection. Author (NSA)

N69-10703# Princeton Univ., N. J. Plasma Physics Lab.
LINEAR MULTIPOLE AND SPHERATOR EXPERIMENTS
S. Yoshikawa, M. Barrault, W. Harries, D. Meade, R. Palladino et al Jul. 1968 27 p refs Presented at 3d Intern. Conf. on Controlled and Plasma Phys., Novosibirsk, USSR, 1–7 Aug. 1968
(Contract AT(30-1)-1238)
(MATT-620; CONF-680805-19) Avail: CFSTI

In both the linear multipole device (LM-1) and the spherator (SP-1), plasma confinement times were found to be limited to $\approx$ 10 times Bohm time in the rf-produced plasmas where density and temperature were such that isotropic pressure distribution was expected. In the linear multipole device, plasma loss is mainly across the magnetic field, while in the spherator, plasma loss is roughly equally divided among limiter loss, support loss, and poloidal field coil loss. With gun-injected plasmas in LM-1, the plasma loss to the end could be increased over that of the loss radially outwards, but the latter is still finite. If we made allowance for the end loss, the confinement times over the Bohm times could be increased up to $\approx$ 50 times. Fluctuations between 1 kc and 1 Mc were observed only in the limited portion of the density profiles (or sometimes none throughout the density profiles), yet the density profiles normalized at the peak density do not change appreciably with time. Author (NSA)

N69-10713# Princeton Univ., N. J. Plasma Physics Lab.
PLASMA CONTAINMENT IN A QUADRUPOLE CONFIGURATION
W. L. Harries, S. Yoshikawa, and R. W. Palladino Aug. 1968 32 p refs
(Contract AT(30-1)-1238)
(MATT-592) Avail: CFSTI

The containment times afterflow plasmas in hydrogen, helium, and neon were measured in a linear quadrupole machine (LM-1) where $n_e \leq 2 \times 10^{12}$, $T_e \leq 10$ eV, $T_i < 1$ eV, mean free path $\lambda \leq 100$ cm, connection length ≈ 20 cm, and electron–ion collision time $\approx 10^{-7}$. Particle collectors showed the losses to be mainly radial. The plasmas in the O dI/B stable region decayed in times of order a millisecond (about 10 times the Bohm value) which increased with I_Q, the conductor current, to a roughly constant value, and decreased as T_e increased. An axial magnetic field which introduced shear ($\theta \geq 1/30$ radians/cm for the main plasma) caused negligible change to the containment time in helium, with a slight improvement in neon. Various instabilities were observed. Pronounced variations in probe signals and plasma loss rates at different axial positions suggested a convective structure which persisted in the afterglow for some milliseconds. The origin of the radial loss inside the stable region may be due to a low-frequency flute-like mode or possibly to the convective structure in the plasma. Author (NSA)

N69-10783# Princeton Univ., N. J. Plasma Physics Lab.
LOW FREQUENCY STABILITY OF AXISYMMETRIC TORUSES
P. Rutherford, M. Rosenbluth, W. Horton, E. Frieman, and B. Coppi Jul. 1968 23 p refs Presented at the 3rd Intern. Conf. on Controlled and Plasma Phys., Novosibirsk, USSR
(Contract AT(30-1)-1238)
(MATT-617; CONF-680805-17) Avail: CFSTI

The low frequency stability of low-β, collisionless plasma in axisymmetric toroidal configurations such as multipoles with and without applied toroidal fields is studied in some detail. Defining the bounce frequency modes are investigated with $\omega > \omega_{be}$, $\omega_{bi} < \omega < \omega_{be}$, and $\omega < \omega_{bi}$. Three classes are found: (1) flute modes, (2) ballooning and drift modes, and (3) trapped particle modes. Stability of the flutes requires with a toroidal field a new generalization of the V'' criterion. Even with these criteria satisfied residual flute instabilities occur depending on resonant particle effects. Author (NSA)

N69-10784# Princeton Univ., N. J. Plasma Physics Lab.
COMPUTER SIMULATION OF PLASMA CONFINEMENT IN A STELLARATOR
Craig G. Smith and A. S. Bishop Jul. 1968 27 p refs Presented at the 3rd Intern. Conf. on Controlled and Plasma Phys., Novosibirsk, USSR
(Contract AT(30-1)-1238)
(MATT-618; CONF-680805-18) Avail: CFSTI

The time-dependent approach to, and stability of, low-density equilibria in toroidal geometry is studied by simultaneously integrating the guiding-center equations of motion for a vast number of particles characterized by a distribution of parallel and perpendicular energies and initial positions. A static magnetic field which models the major effect of stellarator helical windings is used for the calculation, but the self-consistent, time-evolving electric fields are included in the dynamics. Axial symmetry is imposed, but motions parallel to the magnetic field are treated since these are projected on the cross-sectional plane by the rotational transform. Consequently the effect of mirroring and of a parallel electric field are included. In particular, the motion of electrons along field lines to cancel the charge imbalance due to curvature drifts is explicitly treated. In the single calculation performed thus far, the development of azimuthally asymmetric potential surfaces has been observed. Author (NSA)

N69-10790# Uppsala Univ. (Sweden).
ELECTRODYNAMIC STUDIES ON WAVES IN A SYSTEM OF TWO ELECTRONIC COUNTER-STREAMS AND A PLASMA
Anders Jarmen (Ph.D. Thesis) 1968 117 p refs
(NP-17582) Avail: Issuing Activity

The system studied is a parallel plate waveguide filled with a symmetrically located slab composed of a plasma and two counter-streaming electron beams in a background of neutralizing ions. The areas investigated are the following: (1) the cold and unmagnetized system, (2) unmagnetized system with a hot background plasma, (3) the longitudinally magnetized system with a hot background plasma, and (4) nonlinear waves. NSA

N69-10811# Academy of Sciences (USSR), Moscow. Physics Inst.
ELECTRONIC EQUIPMENT FOR MEASUREMENTS OF PLASMA DENSITY AND PLASMA FLUCTUATIONS EXPLORE IN THE STELLARATOR L-1
D. K. Akulina, Yu. I. Nechaev, and I. S. Shpigel 1968 16 p refs
(NP-17587) Avail: CFSTI

One of the methods used earlier for plasma density measurements in Stellarator L-1 was a resonatro method involving excitation of higher-order modes in the vacuum chamber. A modified circuit diagram was proposed for density measurements. Oscillograms are given showing the decay of plasma density with time. A photoelectric spectrum analyzer for studying fluctuations in the Stellarator is described. NSA

N69-10814# Iowa State Univ. of Science and Technology, Ames.
ON COMPLETENESS OF VAPORIZATION DURING BLOWING-IN (INSUFFLATION) OF POWDERED MATERIALS INTO THE PLASMA OF AN ELECTRICAL DISCHARGE
A. K. Tumanov [1968] 9 p refs Transl. into ENGLISH from Zh. Spektrosk, v. 6, no. 285, 1967 p 1–9 Prepared for AEC
(IS-TRANS-76) Avail: CFSTI

During investigation of the insufflation method it was established that the completeness of particle vaporization is increased with increased duration of single discharge action. Recommendations about the arrangement of the electrical system of the source and conditions of analysis are presented, directed toward increasing or decreasing the degree of vaporization. Author (NSA)

N69-10815# Polish Academy of Sciences, Warsaw.
RESEARCH ON PRODUCTION AND CONTAINMENT OF PLASMA IN A SPHERICAL MULTIPOLE MAGNETIC FIELD. 1. THE CONCEPT AND EXPERIMENTAL PROGRAM [BADANIA NAD WYTWARZANIEM I ORGANICZANIEM PLAZMY W UKLADZIE SPERYCZNEGO MULTIPOLA MAGNETYCZNEGO. 1. KONCEPCJA I PROGRAM KSPERYMENTU]
Marek Sadowski 1968 37 p refs In POLISH; ENGLISH summary
(INR-912) Avail: Issuing Activity

Conditions to be fulfilled for effective hot plasma containment are presented. Comparison of different magnetic traps is given, and the concept of plasma confinement involving a spherical multipole magnetic field is discussed. The Kaktus research project is described, and comparison of the geometry or different spherical multipoles is given. Results of investigations of a selected variant of the containment field are also presented. Author (NSA)

N69-10837# Academy of Sciences (USSR), Leningrad. Inst. of Physics.
STUDIES OF TURBULENCE OF HIGH-CURRENT TOROIDAL DISCHARGE PLASMA BY MEANS OF ULTRA-HIGH FREQUENCY PROBING METHOD

M. M. Larionov 1967 14 p refs In RUSSIAN
(NP-17571) Avail: CFSTI

Data obtained from ultrahigh-frequency probing signal fluctuations were used for evaluating the magnitude of relative electron density fluctuations in plasma. The analysis of the ultrahigh-frequency signal fluctuation level confirmed that the spectrum of electron density fluctuation ranges from tens of kHz up to 2 MHz and over. Multiple scattering in the discharge chamber interfered with the accuracy of determination of electron density fluctuation as a function of frequency. NSA

N69-10845# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES Quarterly Report, 1 Dec. 1967–29 Feb. 1968
Herbert Lashinsky 12 Jun. 1968 9 p
(Contract AT(40-1)-3405)
(ORO-3405-19; QPR-9) Avail: CFSTI

Q-machine experiments with the universal drift instability have shown that either discrete or continuous mode spectra may be obtained, depending upon the choice of experimental parameters. "Periodic pulling" has recently been proposed to explain the transition from a discrete spectrum to a continuous spectrum. Work on Q-machine spectra is discussed. NSA

N69-10968*# Michigan Univ., Ann Arbor, Mich. Electron Physics Lab.
MICROWAVE DEVICE INVESTIGATIONS Semiannual Progress Report, 1 Apr.–1 Oct. 1968
W. D. Getty, G. I. Haddad, R. J. Lomax, and J. E. Rowe Oct. 1968 16 p ref
(Grant NGL-23-005-183)
(NASA-CR-97744; SAPR-4) Avail: CFSTI CSCL 20I

Reported are continuing studies of beam-plasma interactions; cyclotron harmonic instabilities; harmonic generation in a beam-plasma system; paramagnetic materials for millimeter and submillimeter wave detection; and bulk semiconductor materials for millimeter and submillimeter wave detectors. Experiments focusing on the development of a relativistic electron beam device for millimeter wave generation were discontinued because of the following inherent problems: (1) poor beam transmission due to thermal effects; (2) alignment problems with various components; and (3) high voltage breakdown. S.C.W.

N69-10977# Japan Atomic Energy Research Inst., Tokyo.
ON THE ELECTRICAL CONDUCTIVITY OF A WEAKLY IONIZED TURBULENT PLASMA. PART 1
Kyoji Nishikawa Jun. 1968 5 p refs Transl. into ENGLISH from Kakuyugo-Kenkyu, no. 16, 1966 p 348–359
(NSJ-TR-122) Avail: Issuing Activity

On the basis of the magnetohydrodynamic equations, the effect of the density fluctuations on the frequency-dependent electrical conductivity of a weakly ionized isothermal plasma is investigated. Only the case in which the magnetic field is static and homogeneous and in which the external electric field is parallel to the magnetic field is considered. The density fluctuations or waves are assumed to be formed by a certain driving force which acts either only on the electrons or only on the ions. The approximations involved are (1) the neglect of the interia term, (2) the neglect of the mode–mode coupling term except when it acts as a driving force and (3) the neglect of the response of the driving force to the external electric field. Some special cases are considered in detail. In particular, when a static density fluctuation is formed by a driving force acting only on the ions, the dc conductivity becomes the same as was obtained by Yoshikawa using a more intuitive argument. Author (NSA)

N69-11073# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IONIZATION OF FAST HYDROGEN ATOMS IN A STRONG MAGNETIC FIELD
Ye. S. Borovik et al 4 Oct. 1967 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSR, Fiz.-Tekhn. Inst. (Kiev), no. 52, 1964 p 3–6
(AD-675254; FTD-HT-23-818-67) Avail: CFSTI CSCL 20/9

The article describes briefly the results of preliminary experiments to determine the fraction, alpha, of 30-kev hydrogen atoms ionized by a Lorentz force in a magnetic field with an intensity of up to 60 kilooersteds. Unlike Sweetmans experiments, in which the value of alpha was estimated from the flux of neutrals produced by the charge transfer of the trapped ions, this study made direct measurements of the number of ions formed when a beam of neutral hydrogen atoms passes through a magnetic field. Author (TAB)

N69-11082# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A HIGH-CURRENT LINEAR INDUCTION ACCELERATOR
N. S. Pedenko et al 4 Jan. 1968 9 p refs Transl. into ENGLISH from the book "Vzaimodeystviye Puchkov Zaryazhennykh Chastits s Plazmoy" Kiev, Naukova Dumka, 1965, p 229–234
(AD-675230; FTD-HT-23-1310-67) Avail: CFSTI CSCL 20/9

A method of generating powerful electron beams and the use of these beams to generate large amplitude electrostatic waves and to heat a plasma are described. The linear betatron constructed for this study consists of an electron source and an accelerating section formed by a power transformer with unity transformation coefficient. The outline of the design is given in a block diagram and its operation is discussed. An electric field of 6 kv/cm was achieved in the accelerating section. The total potential of 200 kv resulted in electron beam currents of 1000 A. The analysis of the design has shown that the most suitable source of energy is a series of capacitors with spark-gap switching. This scheme eliminates synchronization problems and provides a desirable current pulse. The design reported can basically serve as a guide in the construction of a high current accelerator operating in the megavolt range. Author (TAB)

N69-11083# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OSCILLATIONS AND HEATING OF SMALL PLASMA CLUSTERS, IMPINGING ON AN AXIALLY SYMMETRICAL MAGNETIC FIELD
N. A. Khizhnyak 13 Sep. 1967 12 p refs Transl. into ENGLISH from Dokl. Akad. UkrSSR, Fiz.-Tekhn. Inst. (Kiev), no. 114, 1964 p 1 9
(AD-675260; FTD-HT-23-661-67) Avail: CFSTI CSCL 20/9

Estimates are presented for the maximum and minimum of the temperature attained by the plasmoid. TAB

N69-11104# Stanford Univ., Calif. Inst. for Plasma Research.
RESEARCH ON ANOMALOUS DIFFUSION AND INSTABILITIES IN INHOMOGENEOUS PLASMAS Annual Progress Report
K. I. Thomassen and H. Derfler Aug. 1968 48 p refs
(Contract AT(04-3)-326)
(SU-IPR-248) Avail: CFSTI

Instabilities and transport in a cold cathode reflex discharge were studied. Progress on the stabilization of drift waves by externally applied random fields is described. The work on surface-wave instabilities in a bounded uniform-density plasma cylinder which was begun during this contract period is briefly described also. Finally, the design work on a Q machine to be built from an existing thermionic diode is described. Author (NSA)

N69-11107# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoi Energii.
INSTABILITY OF PERIODIC MAGNETO-ACOUSTIC WAVES [NEUSTOICHIVOTS'PERIODICHESKOI MAGNITNO-ZVUKOVOI VOLNY]
V. I. Petviashvili 1966 11 p refs In RUSSIAN
(IAE-1455) Avail: CFSTI

An asymptotic method was used in the theory of nonlinear oscillations in studies of small perturbations in periodic magneto-acoustic waves propagating across a magnetic field in hot plasma or plasma in solids. It was found that such a wave with comperatively high amplitude is unsatable and excites long-wave slow plasma density fluctuations. Author (NSA)

N69-11108# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoi Energii.
INFLUENCE OF THE INTERELECTRODE DISTANCE ON THE STABILITY OF STRAIGHT PINCH IN A QUADRUPOLE HIGH-FREQUENCY FIELD [O VLIYANII RASSTOYANIYA MEZHDU ELEKTRODAMI NA USTOLCHIVOST PRYAMOGO PINCHA V KUADROPOL'NOM VYSOKOCHASTOTNOM POLE]
V. E. Morozov and D. V. Orlinskii 1967 16 p refs In RUSSIAN
(IAE-1486) Avail: CFSTI

Experimental studies were made of the influence of long-wave deformations in a straight plasma pinch on its stability in a quadrupole high-frequency field. Data obtained showed that, at a relatively large distance between electrodes, the observed plasma stability may be explained by maintaining the criterion of stability for a maximum possible length of the deformation wave, while for small electrode distances the results of experiments involving the theory of dynamic stabilization are not in agreement. Author (NSA)

N69-11109# Academy of Sciences (USSR), Moscow. Inst. of Atomic Energy.
TURBULENT PLASMA HEATING IN TORUS
S. D. Fanchenko, B. A. Demidov, N. I. Elagin, and N. F. Perepelkin 1967 8 p refs
(IAE-1485) Avail: CFSTI

An investigation was made in order to determine whether a turbulent-heated torus-shaped plasma could eventually be confined after heating current cutoff. The experiment was carried out in the toroidal discharge chamber of the "Vikhr-2" device. Measurements of oscillations after current cutoff are presented. NSA

N69-11110# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
POSSIBILITY OF USING SUPERHIGH FREQUENCY FIELDS FOR STABILIZING CONVECTIVE PLASMA INSTABILITIES
V. M. Glagolev, I. N. Khromkov, and N. S. Cheverev 1968 23 p refs In RUSSIAN
(IAE-1490) Avail: CFSTI

Experimental studies were made of volume resonator super-high-frequency ($\omega \approx 2 \times 10^{10}$ sec^{-1}) field interactions with plasma ($n \approx 10^{13} \div 10^{14}$ cm^{-3}) in a constant magnetic field. Under the influence of the super high-frequency field a flow of paramagnetic current was observed on the plasma surface; the resulting increase of the static magnetic field inside the plasma was in agreement with theoretical calculations. At $\omega_H/\omega = 0.5$, electron paramagnetic resonance revealed a rapid growth of plasma pressure p_0 up to $\beta_0 = 8\pi p_0/H^2 \approx 0.2$. The possibility of using the paramagnetic effect for stabilizing convective plasma instability is discussed at length. Author (NSA)

N69-11111# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
SUPPRESSION OF PLASMA FLUTE INSTABILITY BY MEANS OF FEEDBACKS
V. V. Arsenin and V. A. Chuyanov 1967 24 p refs In RUSSIAN
(IAE-1444) Avail: CFSTI

A brief review is given of the theory and experiments on suppressing flute instabilities in a trap with injection of fast neutral Ogra II atoms by means of a feedback system, measuring low-frequency electric fields and controlling potentials of certain elements of the vacuum chamber surface. Data obtained indicate that the suggested stabilization system is in good control of the plasma stability. Author (NSA)

N69-11132# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROPAGATION OF WAVES IN PLASMA ACROSS THE MAGNETIC FIELD [RASPROSTRANENIYE VOLN V PLAZME POPEREK MAGNITNOGO POLYA]
A. B. Kitsenko and K. N. Stepanov 27 Oct. 1967 26 p refs Transl. into ENGLISH from Yadern. Sintez (Vienna), no. 4, 1964 p 272–278
(AD-675228; FTD-HT-23-671-67) Avail: CFSTI CSCL 20/9

The propagation of waves in a plasma across a magnetic field is being characterized by interesting features near gyro-frequencies of electrons and ions, as well as frequencies multiple to them. Frequencies of ordinary and extraordinary waves which propagate across a magnetic field in a non-relativistic plasma are determined, and the excitation of high frequency branches of these oscillations are investigated when an ion cyclotron wave passes through the plasma. Various dispersion equations for extraordinary waves are given. The behavioral frequency of various branches of extraordinary waves in hot plasma are described. Author (TAB)

N69-11148# Los Alamos Scientific Lab., N. Mex.
THE DESIGN OF SCYLLAC: A 15-METER THETA-PINCH MACHINE
Edwin L. Kemp [1968] 26 p refs Presented at the 5th Symp. on Fusion Technol., Oxford
(LA-DC-9507; CONF-680710-4) Avail: CFSTI

Scyllac is a theta-pinch machine 15-m long with a 10-cm coil diameter. Two versions will be built, a 15-meter linear model and, later, a 15-meter circumference toroidal model. The same capacitor bank and collector plates will be used for both versions. The machine will be divided into 15 coil, collector plate sections. The 720-kJ primary bank for each section will consist of 216 capacitors, each capacitor having a spark gap and 6 low-inductance coaxial output cables. The cables from each pair of capacitors will terminate at the collector plate in a low-inductance cable cartridge termination. Each collector plate will also have a high-frequency B_z preionization system and a reverse bias, B_θ system. The toroidal system will also include static and dynamic stabilization systems. The design of Scyllac is proceeding in three phases: component development, system development, and system design. The main components being developed are: 1.65-μF, 60-kV capacitor; reliable low-inductance coaxial cable; a low-jitter, 60-kV spark gap; a metal-to-metal, solid dielectric crowbar switch; a low-inductance, cable cartridge termination; plug-in connectors, and miscellaneous hardware. After the components have been approved by the development laboratory they are purchased in substantial quantities and installed and tested in a prototype system. The components which qualify in the prototype system are used in the Scyllac system design. This paper will describe the component developments, the prototype system testing program, and the design of the complete Scyllac system. Author (NSA)

N69-11160# Los Alamos Scientific Lab., N. Mex.
LINEAR THETA-PINCH EXPERIMENTS RELATED TO THE STABILITY OF A TOROIDAL THETA-PINCH OF LARGE ASPECT RATIO

E. M. Little, A. A. Newton, W. E. Quinn, and F. L. Ribe 1968 15 p refs Presented at the 3rd Intern. Conf. on Controlled and Plasma Phys., Novosibirsk, USSR, 1–7 Aug. 1968
(Contract W-7405-ENG-36)
(LA-DC-9324; CONF-680805-20) Avail: CFSTI

In a high-β, toroidal θ pinch (compression field B_z) the outward radial force $(-\beta B^2_\theta a^2/4R)$ due to the major curvature 1 R can be neutralized by introducing radial excursions $a\delta_1 \cos 1\theta \cos kz$ about the minor radius a of the plasma surface. Owing to the periodic regions of unfavorable curvature and to the high β ($\approx$ 0.8 on axis), the equilibrium is grossly unstable to Haas—Wesson modes of the form $\xi_m(z) \cos m\theta$. Results are reported here of experiments on one-meter θ-pinch plasmas with adiabatically applied 1 = 0 bumps both for hot-ion ($kT_i \approx 2$ keV) and cold-ion plasmas with maximum densities n in the range from 5×10^{16} to 1×10^{17} cm^{-3}. Plasma properties β, $kT_i + T_e$), n, and the instability growth rates are established for known B_0 by means of: (a) Faraday rotation measurements of the internal magnetic field; (b) Mach—Zehnder interferometer measurements of the density and plasma shape; and (c) streak-camera measurements of radial plasma motion. For $0.11 \leq \Delta B_\theta/B_0 \leq 0.22$ only the m = 1 mode is observed, and its magnitude is reduced in the hot-ion cases (where end loss is also larger). Small initial negative bias fields B_0 are shown to enhance the m = 1 instability. With quasi-static longitudinal currents $I_z \leq 50$ kA the Kruskal—Shafranov modes are identified and their growth rates measured. The resistance of the current-carrying channel is determined and interpreted when I_z is alternated at frequencies of 0.6–0.8 MHz. No effect of I_z on the plasma density distribution about its axis is seen.
Author (NSA)

N69-11188# Academy of Sciences (USSR), Moscow. Physics Inst.
KINETIC EQUATIONS FOR ELEMENTARY EXCITATIONS AND NONLINEAR INTERACTIONS OF WAVES IN PLASMA
V. N. Tsytovich 1968 131 p refs In RUSSIAN *Its* Preprint No. 12
(NP-17575) Avail: CFSTI

A brief review is given of the basic aspects of the theory of nonlinear wave interactions in plasma. Kinetic plasmon equations, probabilities of interaction processes, and interactions between plasmons and particles are discussed. Uses of the collective excitation method in various problems of turbulent plasma physics—turbulent heating and stochastic particle acceleration, anomalous turbulent plasma radiation, nonlinear effects in electron cyclotron heating processes, nonlinear turbulence generation by electromagnetic waves, and electromagnetic wave scattering on turbulent plasma pulsations—are discussed.
NSA

N69-11216# Academy of Sciences (USSR), Moscow. Physics Inst.
STUDIES OF MECHANISMS OF PLASMA JET CUT OFF BY TRANSVERSE MAGNETIC FIELDS
E. Ya. Gol'ts and A. Z. Khodzhaev 1968 54 p refs In RUSSIAN *Its* Preprint No. 31
(NP-17581) Avail: CFSTI

Physical processes in producing short hydrogen plasma clusters by the cutoff part of plasma jets were investigated. A special device was constructed for determining the longitudinal and transverse polarization of plasma and capture and reflection by magnetic fields. The design and performance of the device are described and probe descriptions are given of reflection, capture, and penetration of plasma through the device gate. Measurement of angles of deflection of ions passing through the gate is discussed.
NSA

N69-11248# Technische Hochschule Stuttgart (West Germany). Inst. fuer Plasmaforschung.
DISCUSSION OF THE RADIATION TRANSPORT EQUATION IN DIFFERENT COORDINATE SYSTEMS [DISKUSSION DER STRAHLUNGSTRANSPORTGLEICHUNG IN VERSCHI EDENEN KOORDINATENSYSTEMEN]
F. Moser and G. Froehlich Dec. 1967 16 p refs In GERMAN
(NP-17460) Avail: CFSTI

The radiation transport equation for spatially expended radiation sources is derived and discussed. The equation is given completely for the following geometries: a plasma channel with rectangular cross section, a plasma cylinder with circular cross section, and a plasma sphere. The scattering in plasma was not considered.
Author (NSA)

N69-11248# Academy of Sciences (USSR), Leningrad.
DAMPING OF THE ULTRAHIGH-FREQUENCY FIELD IN A PLASMA IN CASE OF FIELDS GREATLY EXCEEDING THE CYCLOTRON FIELD
V. N. Budnikov, V. E. Golant, and A. A. Obukhov 1967 8 p refs In RUSSIAN
(NP-17560) Avail: CFSTI

During the propagation of plane waves through a homogeneous, cold collision-free plasma, strong absorption may be expected near the resonance region; these considerations may be extended to nonhomogeneous plasmas. This problem was studied experimentally, examining the absorption of ultrahigh frequency power in a plasma. The authors' earlier experimental system, consisting of a 70-cm long, 2.5 cm wide quartz container, containing hydrogen at a pressure of 10^{-4} to 5×10^{-5} mm of Hg, placed within a 3200 oersted magnetic field, was used. A rectangular waveguide was used to heat the plasma. Measurements based on the signals plotted as a function of the mean concentration indicated that, as the mean concentration approaches the critical one, the signal is sharply attenuated. This phenomenon is practically pressure independent; thus, collisions do not play any part in it. It was found possible to absorb effectively the ultrahigh frequency energy by the plasma in a magnetic field exceeding the cyclotron frequency.
NSA

N69-11250# Academy of Sciences (USSR), Leningrad.
CYCLOTRON HEATING OF PLASMA IONS AND ELECTRONS BY HIGH-FREQUENCY FIELDS
B. V. Galaktionov, K. M. Novik, K. A. Podushnikov, and B. P. Poloskin 1967 11 p refs In RUSSIAN
(NP-17567) Avail: CFSTI

An independent plasma electron heating in a magnetic trap by means of ultrahigh frequency fields and ion heating by means of high frequency fields near cyclotron resonances and their harmonics was achieved on a specially designed device. The device consisted of a glass discharge tube 5 cm in diameter with a quasi-stationary longitudinal magnetic mirror field with mirror ratio 1.85 and a distance of 100 cm between mirrors. Preliminary pumping was up to 10^{-6} mm Hg, the chamber pressure 4×10^{-4} to 2×10^{-3} mm Hg. An ultrahigh-frequency generator of 9100 MHz and 600 V, operating under quasi-stationary conditions with up to 1 sec pulse duration, was used in the experiment. Graphical data are given on the high frequency probe signal, electron concentration, and integrated ion and electron temperature as functions of the magnetic field. The high temperature produced by the fields was achieved under conditions of limited collisions and increased generator power.
NSA

N69-11268#
ON THE LENGTH OF THE IONIZATION RELAXATION ZONE BEHIND A STRONG SHOCK FRONT IN AIR

S. A. Losev et al [1968] 4 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 182, no. 1, Sep. 1968 p 75–76
Avail: CFSTI

The kinetics of air plasma formation in a strong shock has been considered in two extreme approximations as follows: (1) for shock velocities $V \geq 10$ km/sec under the assumption of terminating molecule dissociation, and (2) for $V \leq 9$ km/sec under the assumption of smallness of the effect of ionization on the gas characteristics. For the intermediate range V = 9 to 10 km/sec, predictions of an increase in the length of the nonequilibrium ionization zone L_e behind the shock front with an increase in V were made using the first approximation and were confirmed experimentally using the second approximation. To elucidate the reasons for the detected increase in L_e, the problem of relaxation zone structure behind a strong shock front in air was solved numerically using a digital computer. Presented are results of computer determinations of the ionization process in dissociating air for V = 6 to 10 km/sec. S.C.W.

N69-11285# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES Quarterly Report, 1 Dec. 1967–29 Feb. 1968
H. Lashinsky 29 Feb. 1968 9 p refs
(Contract AT(40-1)-3405)
(QR-9; TID-24649) Avail: CFSTI

Experimental measurements of mode spectra were made in the Univ. of Maryland Q device. The results are briefly described. NSA

N69-11287# Stanford Univ., Calif. Calif. Inst. for Plasma Research.
NONLINEAR INTERACTION OF CYCLOTRON HARMONIC WAVES
K. J. Harker and F. W. Crawford Jun. 1968 34 p refs
(Contract AT(04-3)-326; Grant NSF GK-1711)
(SU-IPR-244) Avail: CFSTI

An analysis was made of nonlinear interaction between cyclotron harmonic waves propagating perpendicular to the static magnetic field in a warm magnetoplasma. It is demonstrated that the synchonism conditions for traveling wave parametric amplification, and passive mode conversion can easily be satisfied for such waves, and an analysis is carried out for a large-signal pump wave interacting with two small-signal waves. The theory employs the Vlasov equation and Maxwell's equations, and provides expressions suitable for numerical computation. Growth rates and corresponding pump powers are computed, and it is concluded that the effect should be observable in typical laboratory plasmas. The paper concludes with a discussion of possible device applications. Author (NSA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N69-10009 Arizona State Univ., Tempe.
THE ELECTRICAL PROPERTIES OF CUPROUS OXIDE AND MANGANOUS OXIDE
Howard Lee McKinzie (Ph.D. Thesis) 1968 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-1653

The conductivity, thermoelectric power, and Hall voltage of cuprous oxide were measured from 25°C to 1000°C in order to obtain a more complete understanding of the conduction process. The sign of Hall voltage was found to be positive at low temperatures and pass through zero to become negative as temperature was increased. Since the thermoelectric power is positive over the whole temperature range, the number of positive charge carriers must be greater than the number of negative charge carriers, and the mobility of the negative charge carrier must be greater than that of the positive charge carrier. The conductivity and thermoelectric power of undoped manganous oxide were measured from 900°C to 1200°C over a range of oxygen pressures. Attempts were made to measure a Hall voltage from 25°C to 1000°C, but no voltage was detected. Dissert. Abstr.

N69-10026 Connecticut Univ., Storrs.
MEASUREMENT OF THE DISSIPATION ASSOCIATED WITH THE ELECTROMECHANICAL COUPLING IN PIEZOELECTRIC CERAMICS
Ralph Storer Woollett (Ph.D. Thesis) 1967 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-1425

Methods were developed for precise measurements of velocity or displacement, including phase angles and magnitudes; and these methods were applied to extend the knowledge of the dissipative parameters of piezoelectric ceramics. After suitable measurement methods were developed, measurements were made of the electromechanical transfer ratios of a number of ceramic samples. There was no simple one-to-one relation between the mechanical displacement and the polarization under stiffness-controlled conditions. The phase angle between the displacement and charge in barium titanate bars with transverse field becomes a lead angle at high drive levels. The amplitude of displacement for these bars is more nearly proportional to the electric field than to the polarization. Some samples were measured under blocked conditions by use of quarter-wave blocking stubs. In this way enough data were obtained to calculate a complete set of two-port parameters. Because of possible influences of the cement joints on the results, the values of the dissipative parameters thus obtained must be treated with some suspicion until corroborating evidence is obtained. Dissert. Abstr.

N69-10032 Rensselaer Polytechnic Inst., Troy, N. Y.
GROWTH AND EVALUATION OF SINGLE-CRYSTAL GALLIUM PHOSPHIDE
Paul E. Bakeman, Jr. (Ph.D. Thesis) 1967 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-812

Close-spaced epitaxial vapor transport of gallium phosphide onto gallium arsenide substrates was chosen for the preparation of single-crystal gallium phosphide. The physical and electrical properties of the resulting single crystals of gallium phosphide were evaluated. NIN and PIN devices were constructed using alloying techniques. Their electrical and optical characteristics were examined and related to the material properties. Single crystals of gallium phosphide with dislocation densities in the order of $10^4/cm^2$ were epitaxially grown on gallium arsenide substrates. Techniques for alloying both P and N contacts to gallium phosphide were developed. Using these, NIN and PIN devices were fabricated. All the epitaxially grown material was high-resistivity N-type. Hall effect and conductivity measurements yieldes values of 4×10^9 ohm-cm and 56 cm^2/volt-sec. for the room-temperature resistivity and Hall electron mobility of a particular wafer. A novel photo-excited Hall effect measurement was made on the same wafer to determine the type and mobility of the photo-excited carriers, which were electrons with a mobility of approximately 180 cm^2/volt-sec. Dissert. Abstr.

N69-10048 California Univ., Los Angeles.
MAGNETIC PROPERTIES OF RARE EARTH METALS AND ALLOYS

Charles Robert Burr (Ph.D. Thesis) 1967 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-243

An erbium-doped magnesium single crystal has been investigated using X band paramagnetic resonance techniques over the region 1.4°K to 4.2°K, and the principal values of the g tensor are $g_{\parallel} = 8.90 \pm 0.1$ and $g_{\perp} = 5.77 \pm 0.1$. The linewidth is anisotropic, varying linearly with temperature in the liquid helium range. Extrapolating the observed linewidths to $T = 0$ an isotropic "residual" width of 110 gauss was found. Calculations show that the ratio of temperature dependent portions of the linewidth for parallel and perpendicular field directions is consistent with an isotropic conduction electron-localized electron exchange interaction with a value of 0.0065 eV. Calculations of g values using a point charge approximation for the crystalline field show that agreement is achieved when the $L = 2$ term is screened approximately 50%. The magnetic susceptibilities of cerium and lanthanum metals have been measured from room temperature through the melting point. Cerium has a unique fusion behavior with a negative melting slope which has been attributed to a 4f–5d electronic promotion. It is demonstrated that this promotion in cerium does not occur and that the small change in the susceptibility at cerium's two high-temperature phase transformations can be attributed almost entirely to changes in the Pauli susceptibility. Dissert. Abstr.

N69-10064 North Carolina State Coll., Raleigh.
INFLUENCE OF Co^{60} GAMMA IRRADIATION ON THE BULK AND SURFACE RECOMBINATION RATES IN SILICON
Michael Anthony Littlejohn (Ph.D. Thesis) 1967 228 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 67-11985

The technique of photoconductive decay in rectangular semiconductor filaments was used to measure the bulk and surface lifetimes and surface recombination velocity of 100 ohm-cm n- and p-type float zone refined silicon doped with phosphorous and boron, respectively. The influence of Co^{60} gamma radiation on the important material parameters was investigated, and a more complete mathematical model for surface recombination velocity was formulated. This model includes the effects of recombination in the space charge region near the surface, and it is shown that this effect can have a significant contribution to the total surface recombination velocity. Dissert. Abstr.

N69-10100 Stanford Univ., Calif.
HOT ELECTRON TRANSPORT IN SILICON AT HIGH ELECTRIC FIELDS
Chun-Yuan Duh (Ph.D. Thesis) 1967 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 67-17411

This report presents a study of certain basic aspects of hot carrier transport in covalent semiconductors at high electric fields, with specific application to hot electron transport in silicon. One of the fundamental material parameters investigated is the saturated drift velocity of hot electrons and its temperature variation. The limiting drift velocity of hot electrons measures the overall scattering strength between hot electrons and various branches of photons either at the center or near the edge of the Brillouin zone. The temperature variation of hot electron drift velocity further differentiates the information of overall coupling strength into proper combinations of different phonon branches. An accurate value of the limiting hot electron drift velocity supplies an important design parameter in the application of high frequency fast-response devices. Dissert. Abstr.

N69-10104 Stanford Univ., Calif.
TEMPERATURE DEPENDENCE AND ANISOTROPY OF MAGNETIZATION OF YTTERBIUM ORTHOFERRITE
Thomas Joseph Beaulieu (Ph.D. Thesis) 1967 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 67-17395

The predominantly antisymmetric nature of the ytterbium–iron exchange was established in ytterbium orthoferrite ($YbFeO_3$) on the basis of measurements of the temperature dependence of the static magnetization of $YbFeO_3$ and related compounds $Yb_xLu_{1-x}FeO_3$ and $Yb_xSm_{1-x}FeO_3$. These latter compounds proved useful in several respects: they allow study of the concentration dependence of the magnetization and flip temperature, and they provided a wider temperature range in which to fit the magnetizations. A spin-hamiltonian treatment of the lowest Kramer's doublet of Yb^{+3} in $YbFeO_3$ predicted a compensation point in $Yb_xSm_{1-x}FeO_3$ for the case of antisymmetric exchange. The experimental observation of such a compensation point indicated that the Yb–Fe exchange interaction was primarily antisymmetric. A smaller amount of symmetric exchange was found to have profound effects on the iron–iron canting angle in $YbFeO_3$. Symmetry allows 2 spin configurations for $YbFeO_3$, labeled σ_x and σ_z depending upon the direction of the net ferromagnetic moment. Dissert. Abstr.

N69-10109 St. Louis Univ., Mo.
SCHOTTKY DEVIATIONS FROM TANTALUM SINGLE CRYSTALS
Michael Stephen Dubas (Ph.D. Thesis) 1967 219 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 68-1262

Selected single crystals (length, 33-mm approximately; grown in 0.005-in. polished pure tantalum wires) were mounted such that the (111) emission currents from 2.9° to 27° of the perimeters of the wires were measured. Pressures were held in the 10^{-10} torr region by ion pumping. Schottky deviation data were obtained for electrostatic fields up to 1.7×10^5 volt-cm^{-1}, $T = 1520$°K. Room temperature emission measurements were obtained for both polished single crystals and an unpolished polycrystalline specimen. All specimens exhibited a room temperature emission for electrostatic fields of approximately 1×10^5 to 1.8×10^5 volt-cm^{-1}. Further calculations suggested that roughness of the emitter surface could contribute to phase shift and amplitude discrepancies between theoretical and observed experimental Schottky deviations. Dissert. Abstr.

N69-10115 Rensselaer Polytechnic Inst., Troy, N. Y.
ULTRASONIC ATTENUATION IN SUPERCONDUCTING MERCURY AND MERCURY–CADMIUM ALLOYS
Charles Preston Newcomb (Ph.D. Thesis) 1967 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-839

The attenuation of longitudinal ultrasound in superconducting mercury was measured using the pulse-echo technique. The samples were single crystals of pure (99.99999%) mercury with the sound propagating along the two- and three-fold axes, a pure polycrystal, and two-fold single crystals doped with from .01 to .1 weight percent cadmium. The attenuation was studied in the frequency range of 10 to 130 MHz. The main purpose of the work was the systematic study of the distinctly non-BCS-like behavior of mercury as a function of cadmium doping concentration, frequency and propagation direction. The behavior was not in agreement with the BCS theory of superconductivity in that the attenuation in the superconducting state decreased much too rapidly near T_c. The rapidity of the drop increased with increasing sound frequency and decreased with increasing cadmium concentration. Dissert. Abstr.

N69-10125*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
MERCURY CADMIUM TELLURIDE AS A 1- TO 20-MICROMETER WAVELENGTH INFRARED DETECTOR FOR SPACE APPLICATIONS

Richard D. Packard Washington Nov. 1968 17 p refs
(NASA-TN-D-4904) Avail: CFSTI CSCL 20L

Mercury cadmium telluride (HgCdTe) offers attractive possibilities for fast, elevated operating temperature infrared detection from 1- to 20-micrometer (μm) wavelengths, particularly in the 8- to 14-μm wavelength region for which it was developed. HgCdTe is considered for use in satellites for terrestrial, atmospheric, and ocean mapping; infrared astronomy; and optical communications. Its chemical stability in the space environment is open to some question; however, experimental data so far accumulated indicate that it is marginally adequate for such purposes. Some attention is given to the possibility of operation using (passive) space radiative cooling; this would eliminate the need for cryogens and provide a much longer operating lifetime as well as reductions in size and weight of the detector system. Author

N69-10128 Marquette Univ., Milwaukee, Wis.
ANALYSIS OF SPACE CHARGE DOMAIN MOTION IN A BULK EFFECT SEMICONDUCTOR
Stanley Vincent Jaskolski (Ph.D. Thesis) 1967 153 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-487

A reasonably simple and valid model of the bulk effect phenomena was developed to allow the study of microwave and millimeter wave generation by a bulk effect device. The model resulted in a unified theory of high frequency generation by a negative resistance bulk effect device, and indicated that a given device can operate in at least five distinct voltage-dependent modes within a given microwave circuit. Experimental results are presented which verify the existence of four of the five distinct voltage-dependent modes of oscillation which were theoretically indicated. The first is a pulsed microwave mode at fields at and about threshold, which allows the device not only to generate microwaves, but also very low frequencies in the kilo-hertz to mega-hertz range. The second is a voltage dependent mode at fields slightly above threshold, with generated frequencies greatly in excess of the Gunn or transit time frequency. The third mode, possessing a relatively narrow field range, is a multi-frequency mode with frequencies on the order of the Gunn transit time frequency. The fourth mode, at fields considerably above threshold, is the voltage independent Gunn transit time mode. Dissert. Abstr.

N69-10135 Illinois Univ., Urbana.
THE MOESSBAUER EFFECT IN IRON COMPOUNDS UNDER HIGH PRESSURE
Allan Richard Champion (Ph.D. Thesis) 1967 169 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-1720

Mossbauer spectroscopy provides a very powerful tool for investigating the electronic structure of solids. The isomer shift is directly related to the s-electron density at a nucleus bound in a crystal lattice, and the quadrupole splitting gives information on local symmetries at the atomic sites. Both isomer shift and quadrupole splitting have a dependence on interatomic distance, and, therefore, the application of high pressure to a sample produces significant changes in its Mossbauer spectrum. An apparatus has been constructed for carrying out Mossbauer investigations at pressures up to 200 kilobars, and the apparatus has been used to study the effect of pressure on the electronic structure of several ferric, ferrous, and covalent iron compounds. It was found that the decreases in isomer shift (increases in electron density at the iron nucleus) with increasing pressure could be correlated with the valence state of the iron. Dissert. Abstr.

N69-10144 Illinois Univ., Urbana.
CRITICAL MAGNETIC FIELDS OF SUPERCONDUCTING TUNGSTEN
William Carter Black, Jr. (Ph.D. Thesis) 1967 171 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-1712

The thermodynamic critical field curve of a superconducting tungsten specimen with resistivity ratio 7,500 has been measured as a function of temperature down to 3 m°K (1 m°K = 10⁻³°K). From the raw data the critical field H_0 at T = 0 is found to be 1.141 ± .007 G, and the zero field transition temperature T_c is 15.39 ± m°K. The normal state electronic specific heat parameter, as derived from the critical field data, is 0.87 ± .04 mJ/mole °K². However, the magnetic field at the specimen is slightly altered by the nearby paramagnetic refrigerant thermometer. Deviation of the measured critical field from a parabolic dependence on temperature is in good agreement with the weak-coupling BCS theory. A large and reproducible, though less than ideal, superheating effect was also observed with this same electropolished specimen. Dissert. Abstr.

N69-10151 Illinois Univ., Urbana.
MAGNETIC SUSCEPTIBILITY AND KNIGHT SHIFT MEASUREMENTS IN ALUMINUM-RARE EARTH ALLOYS
Gary Wendell Stupian (Ph.D. Thesis) 1967 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-1864

Results of measurements of magnetic susceptibility and solvent Knight shift in dilute alloys of rare earth metals in aluminum are reported. Susceptibility results clearly indicated that localized moments exist on each impurity except La, Yb, and Lu, and that coupling between the total spin and the total orbital angular momentum of f electrons is dominant in determining the size of localized moments on solutes. The maximum magnitude of localized moments observed was over $10\mu_B$. Susceptibility studies also showed the deviation from Curie law behavior resulting from the population of excited states. Solvent Knight shift studies permitted a detailed investigation of solute structure because it is influenced only by the polarization of electron spins. Observations show conclusively that the spin magnetization opposes the total impurity magnetization in lighter rare earths while aiding it in heavier rare earths. A quantitative discussion, using scattering theory, of the electron polarization caused by magnetic impurities was found to give a satisfactory account of observed Knight shift changes. A qualitative explanation of the observed NMR solvent line width for the various solutes is also offered. Dissert. Abstr.

N69-10164 Louisiana State Univ., Baton Rouge.
CYCLOTRON RESONANCE IN THALLIUM
Wilbur Lynn Dahlquist (Ph.D. Thesis) 1967 80 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 67-17311

The results of cyclotron resonance measurements in high purity samples of thallium are reported. The measurements were performed at a microwave frequency of 34 GHz in the Azbel–Kaner geometry with the effective mass values being calculated from the periodicity of the subharmonic resonance series observed. The anisotropy of the effective masses in all three principal planes was measured and the various mass branches are assigned to orbits occurring on both parts of the third zone, the fourth zone and the fifth zone sheets of the Fermi surface. Effective mass values are assigned to both portions of the third band. The data for the third zone "crown" agrees well with the known Fermi surface with a value of $m^*/m_0 = .65 \pm .02$ for $\underline{H}$ in the basal plane and $m^*/m_0 = .85$ for $\underline{H}$ along [0001] in the $(11\bar{2}0)$ plane. Dissert. Abstr.

N69-10185 Rensselaer Polytechnic Inst., Troy, N. Y.
ULTRASONIC ATTENUATION IN NORMAL AND SUPERCONDUCTING LEAD
William Arden Fate, II (Ph.D. Thesis) 1967 279 p
Avail: Univ. Microfilms: HC $12.60/Microfilm $3.60 Order No. 68-822

The longitudinal ultrasonic attenuation in normal and super-conducting lead was investigated using the pulse-echo method at frequencies between 10 MHz and 130 MHz in the temperature range 1 to 8°K. The investigation of the amplitude independent attenuation was limited to sound propagation parallel to the [001] direction in single crystal pure deformed lead and well annealed alloys where the amplitude independence of the results was experimentally demonstrated. Methods for extracting electron mean free path values, l, from experimental attenuation data are discussed. The electron mean free path was evaluated for the specimens used in the experiments. The normal state phonon-limited electron mean free path was found to be approximately proportional to T^{-4}. In the normal state the q- and frequency dependence of the attenuation were in good agreement with the Pippard free electron attenuation theory. Dissert. Abstr.

N69-10167 Texas Technological Coll., Lubbock.
THERMOLUMINESCENCE STUDY OF SOME ALKALINE EARTH OXIDES
Edward Donald Taylor (Ph.D. Thesis) 1967 158 p
Avail: Univ. Microfilms: HC $4.70/Microfilm $3.00 Order No. 68-2625

A thermoluminescent study of the alkaline earth oxides (MgO, CaO, SrO, and BaO) was made in order to further the quantitative band models for these systems by determining the nature and relative position of the traps and luminescent centers responsible for thermoluminescence in the band structure of the solid. It was assumed that the luminescence was due to chemical impurities inherent in even the purest samples, and a method was developed for incorporating impurity ions directly into the alkaline earth oxide matrices in order that impurity induced luminescence could be studied. A doping method of making trap assignments was formulated which relied on the concentration quenching of luminescence due to doping. In summary, this work has shown that the thermoluminescence of the polycrystalline alkaline earth oxides seems to be accounted for in terms of impurity activation, and the band theory appears to be the best method of summarizing and explaining the known information about each system. Dissert. Abstr.

N69-10176 Stanford Univ., Calif.
PHOTOEMISSION STUDIES OF THE ELECTRONIC BAND STRUCTURES OF GALLIUM ARSENIDE, GALLIUM PHOSPHIDE, AND SILICON
Richard Carl Eden (Ph.D. Thesis) 1967 322 p
Avail: Univ. Microfilms: HC $14.65/Microfilm $4.15 Order No. 67-17415

Photoemission studies of the electronic energy band structures of gallium arsenide, gallium phosphide, and silicon are reported. The results of measurements of photoemissive yield and energy distributions for photoemitted electrons, as a function of the photon energy of the monochromatic light, are presented for both clean surfaces of GaAs, GaP and silicon, and those surfaces covered with a monolayer of cesium to lower the vacuum level. By using monochromatic light with photon energies up to 11.9 eV, it was possible to study the range of electron final energies from 11.9 eV above the top of the valence band down to the bottom of the conduction band for GaAs and GaP or to near the bottom of the conduction band for silicon (with cesiated surfaces). The overall photoemission results for the three materials are shown to be quite similar, which reflects the basic similarity of their electronic band structures and spectra. Dissert. Abstr.

N69-10222 California Univ., Berkeley.
INVESTIGATION OF HIGH FIELD SUPERCONDUCTING COMPOUNDS
Zelma Johnston Olson (Ph.D. Thesis) 1967 46 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-131

A review of the crystal structure and superconductivity of β-Mn structure compounds is presented here along with a report of the discovery of a new superconductor in this structure (the third of the group mentioned above). The new compound is W_3Re_2C, which has a T_c of 7.4°K. A discussion of the electron-to-atom ratio as applied to these filled interstitial alloys is also included. A study of the effect of microstructure in two phase compounds and alloys of transition metals is presented. One result has been the synthesis of a two phase high-field superconductor with filamentary microstructure (Nb_3Sn in a NbC matrix, critical field higher than 200 kG at low current densities). A second significant accomplishment was the increase of the superconducting transition temperature of Ta-50 pct. Zr alloys by controlling the formation of the precipitate within the miscibility gap composition range of the Ta-Zr system. Dissert. Abstr.

N69-10279 Virginia Univ., Charlottesville.
CHARGE CARRIER MOBILITY IN POLYCRYSTALLINE SEMICONDUCTING FILMS BASED ON BULK SINGLE CRYSTAL THEORY
William David McLennan (Ph.D. Thesis) 1967 59 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-17658

The temperature and thickness dependence of charge carrier mobility in vacuum deposited germanium films can be represented by the relation $1/\mu_a = 1/\mu_L + 1/\mu_I + 1/\mu_d + 1/\mu_F$ where the first three terms represent the lattice, impurity, and dislocation scattering in bulk material. The term μ_F is a function of the surface scattering of the carriers as well as of grain boundary effects. Thus film size effects are represented in a large part by the fourth term which satisfies the empirical relation $1/\mu_F = A \log \sigma/a$. For the films studied, this is the dominant term for polycrystalline films less than 5000 Å in thickness or single crystal films less than 1800 Å in thickness. Dissert. Abstr.

N69-10310 Oregon State Univ., Corvallis.
PROPERTIES OF FLASH-EVAPORATED GALLIUM ARSENIDE AND GALLIUM PHOSPHIDE EPITAXIAL FILMS
Samuel Seiji Matsuo (Ph.D. Thesis) 1968 100 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-2548

The properties of flash-evaporated films of GaAs and GaP were studied in this investigation. Films were grown at various substrate temperatures, source temperatures, source-to-substrate distances and rates of deposition and were evaluated as to their structural, optical and electric properties. It was found that substrate temperature was the major factor in determining the crystallinity of the films. Films deposited below about 250°C were found to be amorphous. As the substrate temperature was increased, the crystallinity of the films improved. The optical data showed that the films had band gaps in the range of 1.34 to 1.72 ev. for GaAs films. Temperature-versus-resistivity measurements showed that the band gap for GaAs films varied from 1.18 ev. to 1.72 ev. The value for bulk GaAs is 1.47 ev. Point-contact and evaporated diodes were fabricated from the flash-evaporated films. Large leakage currents were noted in both types of diodes. Dissert. Abstr.

N69-10319# Finnish Academy of Technical Sciences, Helsinki.
PHOTOCONDUCTIVITY OF HEXAGONAL SELENIUM SINGLE CRYSTALS
T. O. Tuomi (Ph.D. Thesis—Tech. Univ., Helsinki) 1968 38 p refs
Its Acta Polytech. Scandinavica, Phys. including Nucleonics Ser. No. 56
Avail: CFSTI

A barrier model of photoconductivity for hexagonal selenium single crystals is presented. The model is based on the recombination of the current carriers at the dislocations in small angle boundaries. These have been observed by the Guinier-Tennevin method. The theory is compared with experiment by reassuring the

electronic thermoelectric power, the phonon drag and the recombination dependent photoconductivity phenomena in detail. The unusual dependence of the photoconductivity on the light intensity, the extremely slow decay curves are in agreement with the calculations. A typical value for the barrier at the dislocation is found to be 0.8 eV whereas the effective barrier of the small angle boundary is 0.14 eV. The hole-capture cross section for the center at the dislocation is found to be about 10^{-17} cm^2.
Author

N69-10607# Syracuse Univ., N. Y.
COHERENT SCATTERING OF ELECTRONS FROM SHALLOW DONOR PAIRS AND DETERMINATION OF THE SIGN OF THE BINDING ENERGY OF THE SINGLET NEGATIVE PHOSPHORUS ION IN SILICON
A. Honig and R. Maxwell [1968] 12 p refs Paper presented at 9th Intern. Conf. on the Phys. of Semicond., Moscow, 1968
Avail: Issuing Activity

The signs of the singlet and triplet scattering length, a_s and a_t, were determined and consequently, the sign of the binding energy of the singlet phosphorus negative ion in silicon. The necessary condition required for observing coherent scattering of electrons from pairs of neutral impurities is the presence of a sizable fraction of impurity pairs whose interimpurity separation is less than the DeBroglie wavelength of the conduction electrons. This is obtained by selecting sufficiently high impurity concentrations and by using infrared energy radiation near the impurity ionization threshold to produce the conduction electrons. The results of scattering theory were applied to determine the elastic cross sections in the limit of zero energy for isolated impurities and for impurity pairs which scatter coherently. The experimental results show that a_s and a_t have opposite signs; based on the scaled hydrogen model, the triplet unbound hydrogen negative ion yields a negative sign for a_t and the bound singlet yields a positive sign. B.P.

N69-10524*# Houston Univ., Tex. Dept. of Physics.
SPACE RELATED TECHNICAL INVESTIGATIONS Progress Report, 1 Mar.–1 Oct. 1968
Alvin F. Hildebrandt Oct. 1968 32 p refs
(Grant NGR-44-005-022)
(NASA-CR-97482) Avail: CFSTI CSCL 20K

Progress is reported in the following studies: (1) in low temperature physics: determination of critical velocities of superfluid helium flow in wide channels, entrainment of second sound in steady state counter flowing normal and superfluid helium II, and flux quantization in connection with vector potential; (2) in solid state physics: phonon-electron interaction in semiconductors and the resulting velocity shift in sound waves; (3) in atomic physics: spin exchange cross sections of alkali atoms, models for phonon dispersion relations in simple metals, electromagnetic fields of dipoles in arbitrary relativistic motion, and rotation effects on the low temperature thermal properties of crystals; (4) in astrophysics: spectral properties of Comet 1962-III, cometary plasma—solar wind interactions, sodium emissions in comets, and debris and space contamination near manned space vehicles; (5) in flow problems: a French bibliography on differential form application, electrodynamics in rotating frames, an intrinsic theory of fluids, and solar wind termination and the interstellar medium; and (6) in plasma physics: radiation energy spectrum of plasma focus, thermalization in multicomponent plasmas, and cross sections for ion production in neutral-neutral collisions. K.W.

N69-10623# Oak Ridge National Lab., Tenn.
RADIATION-INDUCED PARAMAGNETIC STATES OF SOME INTRINSIC DEFECTS IN ALKALI-GERMANATE GLASSES, POLYCRYSTALLINE GeO_2 AND SINGLE CRYSTALS OF GeO_2, TiO_2 AND SnO_2
Terry L. Purcell Aug. 1968 119 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2264) Avail: CFSTI

Radiation induced paramagnetic states of some intrinsic defects in pure GeO_2 glasses, in GeO_2 glasses with added alkali metal oxide (M_2O/GeO_2 of 0.003, 0.03), and in crystals of GeO_2, TiO_2, and SnO_2 have been investigated by electron spin resonance (ESR) techniques. The ESR measurements were made at 10 GHz and at 300, 77, or 4°K prior to warmup following electron, neutron, and gamma irradiations at temperatures ranging from 77 to 350°K. The irradiated glasses displayed three distinct ESR spectra. The spectrum of gamma irradiated polycrystalline rutile GeO_2 was composed of a single resonance. After irradiation with neutrons, two additional signals were detected. The spectra observed in the glasses and polycrystalline rutile GeO_2 were simulated using a computer and assuming $S = 1/2$ and $I = 0$. On the basis of the calculated g values, spin concentrations, and oxidation-reduction treatments, five of the magnetic complexes were attributed to intrinsic defects. Author (NSA)

N69-10656# Iowa State Univ. of Science and Technology, Ames.
CRITICAL FIELD CURVES FOR SUPER-CONDUCTORS WITH MAGNETIC IMPURITIES
Wayne Reeves Decker (Ph.D. Thesis) May 1968 87 p refs
(Contract W-7405-eng-82)
(IS-T-221) Avail: CFSTI

Critical field curves for thorium with a resistivity ratio of 1200 and three dilute gadolinium–thorium solid solutions were measured by a ballistic induction technique from the critical temperature to 0.3°K. The alloys reported here show characteristics of Type-I superconductors. The data for pure thorium are found to agree to within 0.3% with the theory of Bardeen, Cooper, and Schrieffer over the whole temperature range. Abrikosov–Gor'kov critical field curves for superconductors with magnetic impurities are calculated as suggested by Skalski, Betbeder–Matibet, and Weiss. Measurements for the alloys agree with theory to within 0.5% over the entire temperature range. The specific heat jump at the critical temperature as calculated by the last authors is compared with values obtained from experimental data using Rutger's formula.
Author (NSA)

N69-10704 North Carolina State Coll., Raleigh.
TRANSPORT PROCESSES IN MAGNETOSOLIDMECHANICS
James Robert Reynolds (Ph.D. Thesis) 1967 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 67-17887

The problem of a solid experiencing transport processes in the presence of an applied magnetic field is analyzed on the basis of nonequilibrium thermodynamics. The energy current and electric current are formulated from the linear phenomenological equations relating the fluxes and thermodynamic forces by determining a relationship between the total entropy current and the energy current. The phenomenological tensor components for an isotropic solid with the applied magnetic field at any angle to the solid's physical coordinate axes are determined in terms of the phenomenological tensor components for an isotropic solid with the applied magnetic field in the direction of one of the solid's physical coordinate axes. One transient and two steady state device configurations are analyzed. Dissert. Abstr.

N69-10714# California Univ., Livermore. Lawrence Radiation Lab.
DYNAMIC COMPRESSIVE RHEOLOGICAL BEHAVIOUR OF A BRITTLE, STRAIN RATE SENSITIVE, POLYCRYSTALLINE, ORGANIC SOLID
R. J. Wasley and F. E. Walker 1 Jul. 1968 34 p refs
(UCRL-50446) Avail: CFSTI

The rheological behavior of a brittle, strain-rate sensitive, polycrystalline, organic solid explosive (pressed TNT) was

investigated under conditions of one-dimensional (in the macroscopic sense) compressive strain. The results are reported under compressive loading conditions of both uniaxial strain and uniaxial stress. The work is discussed in four separate but interrelated sections. The wave structure of the uniaxial strain compressive shock within the specimen was deduced by examining quartz crystal pressure transducer stress-time records for both input and output stress disturbances. It was observed that an elastic precursor wave forms in the specimen if the driving stress (the plastic follower wave) is below approximately 10 kbar. Stress-strain-variable strain rate curves were experimentally determined in uniaxial strain for two different specimen thicknesses using the quartz crystal results. All sets of curves were found to be related to specimen thickness in a fashion suggesting a work-hardening mechanism. By using the results from an associated uniaxial stress investigation on the same material, shock hydrostats were estimated at the lower strain levels from the stress-strain-constant strain rate curves most closely in agreement with the Hugoniots. A numerical study indicated the transducer data previously mentioned were not significantly affected by wave reflections and interactions with regard to representing (in a valid fashion) the structure of the emerging disturbance. Author (NSA)

N69-10716 California Univ., Berkeley.
MAGNETIC PROPERTIES OF THE INTERMETALLIC COMPOUND AuMn
William Bindloss (Ph.D. Thesis) 1967 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-33

The results of measurements of the a-axis and c-axis resistivity of a single crystal of the planar antiferromagnet AuMn are reported for the temperature range 4.2–560°K. The resistivity of this material rises rapidly with increasing temperature in the antiferromagnetic region, reaching a value of 61 μ-Ω cm at the Néel temperature of 500°K. Above this temperature the resistivity increases linearly with temperature, but with a smaller slope which is determined by the lattice resistivity. The single crystal measurements show a significant anisotropy in the resistivity which is dependent on the state of the spin system. The temperature dependence and the anisotropy of the resistivity are analyzed, taking into account the effects of superzone boundaries associated with the spin ordering, and also the presence of an anisotropic spin-disorder contribution. The superzone boundaries introduce a relatively small anisotropy into the resistivity ($\approx$ 8% at T = 4.2°K), such that $\rho_c > \rho_a$; while the spin-disorder resistivity contributes a much larger anisotropy of the opposite sign in the temperature region 200–500°K. Dissert. Abstr.

N69-10778# Washington Univ., Seattle. Dept. of Physics.
STATISTICAL MECHANICS OF AN IMPURE CRYSTAL AT LOW TEMPERATURES
J. G. Dash 1968 26 p refs Supported by NSF
Avail: Issuing Activity

A simple model of a regular crystal containing a dilute concentration of interstitial impurities is analyzed with particular attention to thermal properties at low temperatures. Tunneling produces a lifting of the degeneracy of the spatial configurations of the impurities among the interstitial sites, and the consequent impurity band energy structure is studied under various conditions of temperature and impurity concentration. At relatively high temperatures the tunneling band entropy S approaches the conventional value corresponding to static impurities in random solution. At lower temperatures S decreases. At temperatures below T_t, thermodynamic properties approach those of ideal gases. For sufficiently low T, the impurities undergo Fermi or Bose condensation. The general dependence of S on T and T_t suggests that it may in principle be used for refrigeration, the ultimate temperatures possible in an ideal substance being on the order of 10^{-12} deg. Author

N69-10817# General Technology Corp., Lawrenceville, N. J.
COMPATIBILITY CONDITIONS OF THE THEORY OF MICROMORPHIC ELASTIC SOLIDS
A. Cemal Eringen Washington NASA Nov. 1968 19 p refs
(Contract NASw-1589)
(NASA-CR-1236; TR-8-5) Avail: CFSTI CSCL 20L

The compatibility conditions for the strain measures of the theory of micromorphic elastic solids are presented. Specific forms are given for the linear theory and for the linear micropolar elasticity. Author

N69-10842# Carnegie-Mellon Univ., Pittsburgh, Pa. Metals Research Lab.
A STUDY OF THE INTERACTION BETWEEN POINT DEFECTS AND DISLOCATIONS THROUGH DISLOCATION DAMPING EXPERIMENTS Final Report
Charles L. Bauer 1 Jun. 1968 7 p refs
(Contract AT(30-1)-3001)
(NYO-3001-2) Avail: CFSTI

A review of work conducted from 1962 to 1968 on dislocation damping measurements of segregation of Ge solute atoms in Ge–Cu alloys, structure sensitivity of Type II semiconductors, internal friction, Young's modulus, and superconductivity of Nb, thermal depinning of dislocations from solute atom pinning points, and relation of strain amplitude dependence of internal friction to the magnetic state of Nb monocrystals. Sections reviewed were previously published as doctoral theses or journal articles. NSA

N69-10884 Stevens Inst. of Tech., Hoboken, N. J.
FLUX FLOW RESISTANCE IN THIN FILMS OF TIN
Hans Meissner and Paul Tholfsen [1968] 5 p Presented at Conf. on AC Superconductivity, Warwick, Engl., 1968 Supported in part by NSF
Avail: Issuing Activity

An overview is presented on the apparatus used to study flux flow resistivity in thin type 1 superconducting films, and two precautions which must be observed in making such measurements are stated. These are: (1) To reduce the perpendicular component of the magnetic field, it is necessary to return the current through a silver film parallel to the film under investigation and quite close to it. (2) In order to trace out V–I curves up to large currents without danger to the sample and with negligible heating effects, pulsed currents must be used. Several plots are included on the V–I curves and flux flow resistivities for tin films of various thicknesses and at different temperatures. M.G.J.

N69-10886# Iowa State Univ. of Science and Technology, Ames.
HIGH FIELD MAGNETIZATION OF THULIUM SINGLE CRYSTALS
Durkee Benham Richards (Ph.D. Thesis) May 1968 73 p refs
(Contract W-7405-eng-82)
(IS-T-220) Avail: CFSTI

A magnetometer was designed and constructed to be used in a 1.01-inch-bore superconducting solenoid wound with Nb_3Sn ribbon. It is of the vibrating-sample type and uses a null method in which the signal from the sample pickup coils is nulled out with a reference signal generated by a transducer on the sample rod. A bridge circuit is used to allow nulling the in-phase and quadrature components separately. With this magnetometer, the magnetization of thulium was measured along the (1010) and c-axis directions from 4.2 to 300°K and in magnetic fields up to 100 kOe. Low-field iso-fields for both directions indicate a Néel temperature of 58°K. The isotherms for both directions below 58°K show a large anisotropy favoring the c axis, and suggest that the antiferromagnetic structure below 58°K is an axial structure oriented along the c axis. The low-field isofield for the c axis shows that at about 42°K the antiferromagnetic structure begins to square up, and at about 25°K has become a ferrimagnetic structure with a net moment along the c axis at 4.2°K of 1.0 μ_B per atom. Author (NSA)

N69-10887*# Case Western Reserve Univ., Cleveland, Ohio.
IMPURITIES AND INTERFACE STATES IN THE SILICON DIOXIDE/SILICON SYSTEM. Final Report
Alan B. Kuper 1 Sep. 1968 47 p refs
(Grant NGR-36-003-087)
(NASA-CR-97738) Avail: CFSTI CSCL 20L

Research was conducted to improve device process yields and to increase reliability of silicon planar devices. Work was conducted in three main areas: oxide hydration, interface-states, and gold effects. Results of this research were: (1) Hydration of thermal oxide on Si at moderate temperatures analyzed by tritium profiles as a function of time, temperature and pressure, suggests oxide porous structure. (2) Interface-states between oxide and Si controllably produced by dry nitrogen baking between 500 and 700°C. (3) MOS photocapacitors built and tested. (4) Combined electrical-radiochemical analysis of gold in Si near interface conducted by diode storage time and by MOS transient methods. Author

N69-10892# Maryland Univ., College Park. Dept. of Physics and Astronomy.
CRITICAL FIELD RATIO H_{c3}/H_{c2} FOR PURE SUPERCONDUCTORS OUTSIDE THE LANDAU-GINZBURG REGION. 1. T=0°K
Chia-Ren Hu and Victor Korenman Sep. 1968 43 p refs
Presented at the Am. Phys. Soc. 1968 Submitted for publication
(Contracts N00014-67-A-0239-003; DAHC-04-67-C-0023; Grants AF-AFOSR-735-65; AF-AFOSR-68-1459; Proj. Defender)
(AD-674051) Avail: CFSTI CSCL 20/3

In this paper and a subsequent one (Part II) we study the nucleation of superconductivity near a sample surface at temperatures outside the Landau-Ginzburg region. We develop a generalized image method to solve for the normal electron temperature-Greens-function, for a semi-infinite sample with a specularly reflective plane boundary, in an external magnetic field. Gorkovs linearized gap equation is then obtained and studied for such a sample geometry. The pair wave function delta is found to obey the Landau-Ginzburg boundary condition at all $T<Tc$, even though this boundary condition was originally suggested only for the Landau-Ginzburg region (i.e. when $Tc-T<<Tc$). However, we also find that merely adding the boundary condition to the differential equation appropriate to the bulk case, does not give the correct solution to the problem, except when $Tc-T<<Tc$. At $T = 0$ K, the integral gap equation is solved by a variational approach, yielding the critical field ratio $Hc3/Hc2 > or = 1.925$. Author (TAB)

N69-10897# Pennsylvania State Univ., University Park. Materials Research Lab.
MATERIALS PREPARATION AND CHARACTERIZATION Annual Technical Progress Report, 1 Jul. 1967–30 Jun. 1968
Aug. 1968 156 p refs
(Contract DA-49-083-OSA-3140)
(AD-67[illegible]) Avail: CFSTI CSCL 20/12

Contents: Over-view of laboratory activity; Summaries of research results: Preparation of materials; Characterization of materials; Properties of materials; Research on glass; Solid state bioscience and geoscience; Science and technology transfer. TAB

N69-11005# Battelle-Northwest, Richland, Wash. Pacific Northwest.
PRESSURE INDUCED RECOVERY OF IRRADIATION DAMAGE IN MOLYBDENUM
G. L. Kulcinski, H. E. Kissinger, and B. Mastel 25 Jul. 1968 23 p refs Presented at the Intern. Conf. on Vacancies and Interstitials in Metals, Juelich, Germany
(Contract AT(45-1)-1830)
(BNWL-SA-1835; CONF-680910-3) Avail: CFSTI

Results of investigations are presented concerning the effects of pressure on annealing of radioinduced defects in Mo. Information is included on the activation volume of the defect involved in the third annealing stage and the effects of pressure on the thermal stability of defect clusters in irradiated Mo. NSA

N69-11028# California Univ., Livermore. Lawrence Radiation Lab.
TESTING COMPOSITE SUPERCONDUCTOR FOR THE LRL BASEBALL MAGNET
Robert L. Nelson and Carl D. Henning 1 Aug. 1968 19 p refs Submitted for publication
(Contract W-7405-eng-48)
(UCRL-71022; CONF-680813-2) Avail: CFSTI

Testing of a square composite superconductor to be used in the large baseball magnet now under construction at LRL Livermore is described. Sample conductors, purchased from five suppliers, were comparable in quality and performance to that required for the baseball magnet. To produce the external magnetic field for conductor testing, a "split-pair" magnet was built of niobium–tin superconducting tape. The solenoids of each sample superconductor were located in the high field region between the halves of the "split-pair" magnet, and then energized. For comparison, the short-sample conductor performance was measured and plotted along with the solenoid performance. In addition, a correlation was obtained between current-sharing characteristics of a superconductor and magnet stability. Author (NSA)

N69-11237# Carnegie-Mellon Univ., Pittsburgh, Pa. Metals Research Lab.
THE INTERACTION BETWEEN POINT DEFECTS AND DISLOCATIONS THROUGH DISLOCATION DAMPING EXPERIMENTS Final Report
1 Jun. 1968 7 p
(Contract AT(30-1)-3001)
(TID-24562) Avail: CFSTI

SOLIDS– dislocation interactions with point defects in; studies COPPER ALLOYS & SYSTEMS– dislocation interactions with solute atoms in dilute, studies SUPERCONDUCTORS– dislocation interactions in Type II, studies NIOBIUM– superconductivity of, dislocation interaction studies INTERNAL FRICTION–measurements in alloys and superconductors NSA

N69-11256 Brown Univ., Providence, R. I.
BAND STRUCTURE AND OPTICAL CONSTANTS OF InSb, InAs, AND GaSb: THE VECTOR $\vec{k}\cdot\vec{p}$ METHOD
C. W. Higginbotham, F. H. Pollak, and M. Cardona 1968 15 p refs
(Grants NSF GP-5409; NSF GP-4815)
Avail: Issuing Activity

It has been shown that a modified $\vec{k}\cdot\vec{p}$ Hamiltonian referred to 30 basic states at $\vec{k}=0$ provides a good representation of the band structure of zincblende materials, including spin-orbit effects, in the region of fundamental optical transitions. From the band energies and their eigenvectors throughout the entire Brillouin zone (BZ), the matrix elements of the linear momentum $\vec{p}$ and combined density of states have been calculated to obtain the real [$\epsilon_1(\omega)$] and imaginary [$\epsilon_2(\omega)$] parts of the complex dielectric constant in the region 0–10 eV. These are the first calculations of the optical constants of these materials which include spin-orbit effects. In addition we have determined mass parameters at several points in the BZ, g-factors at $\vec{k}=0$, and the individual density of states for these materials. The contribution of direct interband transitions to $\epsilon_2(\omega)$ is given in atomic units. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N69-10347*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center.

INVESTIGATION OF LIGHT HYDROCARBON FUELS WITH FLUORINE OXYGEN MIXTURES AS LIQUID ROCKET PROPELLANTS Final Report

A. I. Masters 15 Nov. 1968 108 p refs

(Contract NAS3-10294)

(NASA-CR-72425; PWA-FR-2872) Avail: CFSTI CSCL 21K

The feasibility of regeneratively cooling a flox-methane engine with bulk boiling methane was shown analytically and demonstrated experimentally. Both supplementary and regeneratively cooled simulated altitude tests were run at nominally 5000-lb thrust, 100-psia chamber pressure in modified RL10 tubular thrust chambers having nozzle expansion ratios of 40:1. The most severe cooling problems were determined and solutions to these problems investigated. Regenerative cooling applicability with bulk boiling methane was predicted with regard to thrust and chamber pressure limits. Performance data were obtained in 25 uncooled simulated altitude test firings with bell-shaped and conical nozzles. Author

N69-10397*# Rocketdyne, Canoga Park, Calif.

EVALUATION AND DEMONSTRATION OF THE USE OF CRYOGENIC PROPELLANTS (OXYGEN/HYDROGEN) FOR REACTION CONTROL SYSTEMS. VOLUME 2: EXPERIMENTAL EVALUATIONS AND DEMONSTRATION Final Report

N. Rodewald, G. Falkenstein, P. Herr, and E. Prono Jun. 1968 332 p refs

(Contract NAS3-7941)

(NASA-CR-72244; R-6838-2) Avail: CFSTI CSCL 21I

The feasibility of a catalytically ignited spacecraft reaction control system using cryogenic (hydrogen-oxygen) propellants was experimentally demonstrated. The system studied utilized propellant conditioners to prepare the incoming propellants to a temperature and pressure acceptable to the thrustor. A portion of the propellants at a mixture ratio of 1.0 was passed through a catalyst bed. Additional oxygen was injected into the hot fuel-rich gas. Experimental results for the thrustor and conditioner subsystems and a system demonstration are presented. Design criteria for the ultimate development of an operational system are also presented. Author

N69-10402 Virginia Polytechnic Inst., Blacksburg.

THE EFFECT OF VACUUM ON THE MECHANICAL PROPERTIES OF A SOLID ROCKET PROPELLANT DURING SPACE STORAGE

Lawrence Ronald Greenwood (Ph.D. Thesis) 1967 181 p

Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-2047

The program was concerned with the determination of the effect of vacuum on the mechanical properties of a composite solid rocket fuel during space storage. The propellant studied was a sterilized composite of polybutadiene acrylic acid-ammonium perchlorate. Tensile samples were stored in vacuum, in dry nitrogen at atmospheric pressure, and in ambient air at atmospheric pressure. The mechanical properties of these samples were measured as a function of storage time for a period of 32 days. In addition, average molecular weights and crosslink density were measured for vacuum and ambient samples. Supplementary studies were made to determine the weight loss in vacuum. A mass spectrometer was used to analyze the outgassing constituents during vacuum exposure. Dissert. Abstr.

N69-10659# Joint Publications Research Service, Washington, D. C.

EFFECT OF INGREDIENT PARTICLE SIZE ON BURNING VELOCITY OF COMPOSITE SYSTEMS AT VARIOUS FUEL/OXIDIZER RATIOS

Yu. A. Kondrashkov et al 28 Oct. 1968 7 p refs Transl. into ENGLISH from Fiz. Goreniya i Vzryva (Moscow), no. 3, 1967 p 339–343

(JPRS-46758) Avail: CFSTI

The dependence of the combustion rate upon the dispersed state of the components was studied for NH_4ClO_4 and $KClO_4$ mixtures with organic fuels. Results showed that anomalous patterns developed in the burning velocity if particle dimensions were large in the NH_4ClO_4 mixture with polystyrene and polymethyl methacrylate. In proportion to the particle dimension increase, the burning rate dropped to a certain limit, passed through a minimum, and then increased gradually. This phenomenon was attributed to heat yield in the tip of the flame. G.G.

N69-10799# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Raketentreibstoffe.

THEORETICAL PERFORMANCE OF THE MULTICOMPONENT ROCKET PROPELLANT SYSTEM $(O_2,F_2)/(Be,LiH)/H_2$ [THEORETISCHE LEISTUNGEN DES VIELKOMPONEN ENRAKETENTREIBSTOFFSYSTEMS $(O_2,F_2)/Be,LiH)/H_2$]

R. E. Lo Sep. 1968 64 p refs In GERMAN; ENGLISH summary

(DLR-Mitt-68-21; DVL-797) Avail: CFSTI

Specific impulses at 10:0.01 expansion into vacuum and 10:1 expansion into ambient pressure have been calculated for the system $(O_2,F_2)/(Be,LiH)/H_2$ at equilibrium and frozen flow conditions. The O_2/Be ratio was stoichiometrical while the F_2/Li ratio varied between 0 and 2. The beryllium content of the solid fuel mixture varied between 0 and 100%. The hydrogen content has been optimized for all combinations. Theoretical temperatures and compositions of exhaust gases in chamber, throat and at end of nozzle are plotted against hydrogen content for all mixtures with stoichiometric metal-oxydizer ratio. The results confirm lithiumhydride as a potentially useful highenergetical binder for the realization of tribrid beryllium combustion. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N69-10154# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.

MODULAR HYPERSONIC INLETS WITH CONICAL FLOW

S. Moelder and J. M. Romeskie *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 22 p refs Supported in part by Johns Hopkins Univ. (See N69-10186 01-01) (Grant NRC A-4190)

Avail: CFSTI

A series of requirements is established for the design of high performance hypersonic air intakes. A method, based on axisymmetric conical flow, is presented for the design of axisymmetric and non-axisymmetric air intakes. Theoretical estimates of the performance of these intakes are presented along with computer drawings of inlet shapes and geometric construction of modular inlets. Experimental results are given for an axisymmetric Busemann inlet tested in a gun tunnel at Mach 9.33 and a unit Reynolds

number of 6×10^6 per foot. Results of surface static pressures and oil streaks are presented. The surface contour is corrected for a laminar boundary layer displacement thickness and the corrected results are given. Total pressure recoveries are measured. Surface pressure, surface flow visualization, and total pressure recovery results are given a modular inlet design. Author

N69-10221# Aeronautical Research Labs., Melbourne (Australia).
THEORETICAL ANALYSIS OF A CONSTANT-VOLUME GAS TURBINE
M. Zockel Jul. 1968 22 p refs
(ARL/ME-298) Avail: CFSTI

Gas turbines currently used in aircraft and industrial applications work on the steady-flow, constant-pressure cycle which means that the addition of energy is achieved by raising the temperature of the gases without increasing the pressure. The advantages of this design are that the combusion chamber is effectively a simple duct which imposes the least possible restriction on the flow and that the flow through compressor and turbine is steady. On the other hand the disadvantages of the constant-pressure combustion shaft turbine are higher specific fuel consumption and lower specific power when compared with high-speed reciprocating engines which use effectively constant-volume combustion. Consequently, only in certain applications, for example military and commercial aircraft, where low specific fuel consumption is secondary to specific weight, is the constant-pressure shaft turbine superior to the reciprocating engine. It is the aim of this paper to consider the main advantages and disadvantages of a pulsating-flow, constant-volume combustion gas turbine in the power range 50 to 350H.P. Author

N69-10229*# TRW Systems Group, Redondo Beach, Calif.
ALL METAL EXPULSION SYSTEM USING VOLATILE LIQUID PRESSURIZATION Final Report
R. G. Estough 11 Oct. 1968 261 p refs
(Contract NAS9-4550)
(NASA-CR-92367; TRW-05019-6001-R0-00) Avail: CFSTI CSCL 21H

The design, development, fabrication, and testing of two flight-weight volatile liquid all-metal expulsion systems is documented. Volatile liquid expulsion pressurization provides an improved method of expelling storable propellants for RCS engines by eliminating the need for a pressurant high pressure storage and distribution capability. The system utilizes the energy resulting from the phase change of a volatile liquid caused by a controlled heat input. Parameters to consider in volatile liquid selection and system design are presented. Typical test expulsion characteristics of subscale and flight-weight systems are described. Author

N69-10296*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF VARIABLE STATOR AREA ON PERFORMANCE OF A SINGLE-STAGE TURBINE SUITABLE FOR AIR COOLING. 5: STATOR DETAILED LOSSES WITH 70 PERCENT DESIGN AREA
Herman W. Prust, Thomas P. Moffitt, and Bernard Bider Washington Nov. 1968 26 p refs
(NASA-TM-X-1698) Avail: CFSTI CSCL 21E

The turbine is being investigated at stator area settings of 70, 100, and 130 percent of design. This report presents the experimental and analytically predicted results for the stator having a closed (70 percent) area setting and compares these results with similar results obtained for the design (100 percent) area and open (130 percent) area settings. The final results are presented in terms of kinetic energy loss coefficients as a function of velocity level. The experimental losses were close to those predicted analytically and indicate a stator efficiency of about 96 percent. Author

N69-10390*# Curtiss-Wright Corp., Wood-Ridge, N. J. Wright Aeronautical Div.
THE DEVELOPMENT OF A SEGMENTED, AXIALLY CONDUCTING, PYROLYTIC GRAPHITE REACTION CONTROL ENGINE Quarterly Report, 15 Dec. 1965–14 Mar. 1966
14 Mar. 1966 122 p
(Contract NAS9-5424)
(NASA-CR-97596; WAD-R-572-Q-1; QR-1) Avail: CFSTI CSCL 21H

The objective of this program is to demonstrate a flight type configuration of an axially conducting engine in which pyrolytic graphite wedges, restrained by an elastic structure, form the combustion chamber and nozzle of the engine. The design of a rig engine, including thermal and structural analyses, was completed, and fabrication of parts for the first engine build was begun. Author

N69-10511*# Curtiss-Wright Corp., Wood-Ridge, N. J. Wright Aeronautical Div.
THE DEVELOPMENT OF A SEGMENTED, AXIALLY CONDUCTING, PYROLYTIC GRAPHITE REACTION CONTROL ENGINE Quarterly Report, 15 Sep.–14 Dec. 1966
14 Dec. 1968 102 p
(Contract NAS9-5424)
(NASA-CR-97480; WAD-R572-Q4; QR-4) Avail: CFSTI CSCL 21H

The objective of this program is to demonstrate a flight type configuration of an axially conducting engine in which pyrolytic graphite wedges, restrained by an elastic structure, form the combustion chamber and nozzle of the engine. Fabrication and cold flow testing of the integral spray injector for the flight engine configuration were completed. Initial hot firing evaluation of the injector indicated a low frequency instability problem. Design revisions intended to correct the problem are in process. Author

N69-10666*# Curtiss-Wright Corp., Wood-Ridge, N. J. Wright Aeronautical Div.
THE DEVELOPMENT OF A SEGMENTED, AXIALLY CONDUCTING, PYROLYTIC GRAPHITE REACTION CONTROL ENGINE Quarterly Report, 15 Dec. 1966–14 Mar. 1967
14 Mar. 1967 94 p
(Contract NAS9-5424)
(NASA-CR-97613; WAD-R572-Q5; QR-5) Avail: CFSTI CSCL 21H

This is the fifth quarterly report covering the work performed during the period from December 15 through March 14, 1967. The objective of this program is to demonstrate a flight type configuration of an Axially Conducting Engine (ACE) in which pyrolytic graphite (PG) wedges, restrained by an elastic structure, form the combustion chamber and nozzle of the engine. Development of the integral spray injector for the flight engine configuration was continued through this period. Testing indicated the modifications required to obtain stable engine operation, and design revisions intended to correct the problem are in process. Author

N69-10680*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
SIMULATED RADIOISOTOPE THRUST SYSTEM AND COMPONENT DEVELOPMENT Final Report
R. E. Viventi, W. N. Neiman, and W. F. Zimmerman [1968] 254 p
(Contract NAS5-9670)
(NASA CR-97586; GESP-87) Avail: CFSTI CSCL 21F

A single-jet thruster designated T6K 2000-1P was designed, fabricated, performance tested and preflight qualified. A more complex thruster, consisting of four attitude-control thrusters and

one station keeping thruster grouped around a common heater was also designed, fabricated, and tested. Two versions of a radioisotope-heated thruster were fabricated–one with a radioisotope heat source and the other with an electrical simulator. A higher temperature (3000 ° F) simulated radioisojet thruster was designed after preliminary heater tests had been performed satisfactorily. An ammonia decomposition catalyst study was performed with decomposition demonstrated at temperatures as low as 1500 ° R. One of the TSK 2000-1P thruster bodies was modified to include a catalyst bed and a significant increase in delivered specific impulse was seen. A major effort was made to develop a long-life heater to operate at 2000 ° F for 10,000 hours. A 6800-hour life and a cycle life of over 120 cycles from room temperature to 2000 ° F were demonstrated. Author

N69-10712*# Boeing Co., Seattle, Wash. Missile and Information Systems Div.

LIQUID HYDROGEN POSITIVE EXPULSION BLADDERS Final Report

Karl E. Wiederkamp. May 1968 86 p refs

(Contract NAS3-11192)

(NASA-CR-72432) Avail: CFSTI CSCL 21H

Liquid hydrogen expulsion tests were performed using multi-ply bladders fabricated from Mylar, Kapton and an experimental polyester film. The effects of the outward expulsion mode and of an integral collapse control device on hydrogen diffusion and cyclic expulsion endurance were determined. Two bladders were able to complete 25 expulsion cycles, although interply inflation and some gas leakage was noted in all bladders tested. Author

N69-10781*# Marquardt Corp., Van Nuys, Calif. Materials and Process Dept.

DEVELOPMENT OF A DUCTILE COLUMBIUM ALLOY ROCKET ENGINE COMBUSTION CHAMBER

E. Ritchie 26 Sep. 1967 143 p

(Contract NAS9-6003)

(NASA-CR-97479; TMC-S-843) Avail: CFSTI CSCL 21H

The niobium-base alloy C-103 with the R-512A silicide coating has been selected as the most promising material coating system for combustion chambers of the type used for the Apollo reaction control rocket engine. This report summarizes the investigations leading to the selection of the C-103/R-512A system and presents the results of the coating study. The service life of the R-512A coating was determined at temperatures up to 2800°F and during operation in a space environment (vacuum sublimation). The ability of the R-512A coating to retard the absorption of the interstitial gases and the effects of the gases on the cryogenic ductility of the coating system were investigated. The spectral and hemispheric emissivity and solar absorptivity of the coating were measured. K.W.

N69-10850*# Marquardt Corp., Van Nuys, Calif.

RESULTS OF THE PRETEST ANALYSIS OF THE APOLLO SM-LM RCS ENGINE WHEN OPERATED AT SEVERE OFF-LIMITS TEST CONDITIONS

R. L. Moffett 28 Oct. 1968 52 p refs

(Contract NAS9-7281)

(NASA-CR-92382; S-899) Avail: CFSTI CSCL 21H

Analyses were performed to determine the steady state and pulsing performance, to evaluate the thermal effects to the preigniter and molybdenum combustor, and to evaluate engine ignition when operating at test conditions simulating clogged propellant system filters. The results show that the tip of the preigniter may possibly be eroded on two of these system failure simulation runs. Additionally, the analyses show that, at several of the test conditions simulating serious filter clogging, inconsistent preigniter operation can be expected accompanied by long ignition delays. Possible combustor damage can result from ignition overpressures that might be caused by the excessive ignition delays. The performance and thermal analyses of the simulated clogged filter tests are also applicable for the simulated regulator failure tests. The reduced flow caused by regulator failure may lead to erosion of the preigniter tip due to insufficient fuel cooling. Author

N69-10885*# Curtis-Wright Corp., Wood-Ridge, N. J.

DEVELOPMENT OF A TURBOJET COMBUSTOR WITH A SEGMENTALLY CONSTRUCTED LINER Final Summary Report

D. Biondi and S. Draizen 24 Jun. 1968 195 p refs

(Contract NAS3-7908)

(NASA-CR-54835; WAD-R-437) Avail: CFSTI CSCL 21E

Durability of conventionally designed combustor liners is compromised due to the thermal stresses encountered in the severe combustor environment. The large temperature gradients and thermal cycling induce thermal stresses which can cause buckling and local plastic flow or liner cracks. Severely warped liners with abnormal temperature distribution can cause burned turbine blades and possible engine loss. The development effort reported herein resulted in a unique liner design directed toward alleviating the thermal stresses. The liners were segmented in both the axial and circumferential direction. The segmented liners, by permitting unrestrained thermal expansion of adjoining elements, reduced thermal stresses. This should result in an extended service life. Further, the individual segments can be replaced, where necessary, without the need for an entire new liner assembly. The liner assemblies were successfully tested to combustor air inlet temperature and pressure of 1150°F. and four atmospheres, with combustor gas outlet temperature of 2200°F. Ten percent of total airflow was used for liner cooling. This flow provided .0036 pounds coolant/sec/in^2 of liner surface at the four atmosphere condition. Author

N69-10882*# Mississippi State Univ., State College. Engineering and Industrial Research Station.

RESEARCH STUDY FOR DETERMINATION OF LIQUID SURFACE PROFILE IN A CRYOGENIC TANK DURING GAS INJECTION Quarterly Report, 18 Dec. 1967–17 Mar. 1968

William D. McCain, Jr., James T. Smith, and Thomas J. Rice 18 Mar. 1968 41 p

(Contract NAS8-11334)

(NASA-CR-97672; QPR-15) Avail: CFSTI CSCL 21H

Efforts continued on developing a correlation equation which sufficiently describes the entrainment–viscosity behavior. The equation is based on the general relationship $E = A + B \ln \mu$, where E is the fractional entrainment, A and B are constants which must be determined for each different value of Reynolds number and time, and μ is the dynamic liquid viscosity. Figures are included to depict entrainment versus viscosity for the 1/4-filled and 1/2-filled cases at different time intervals for various air flow rates. M.G.J.

N69-11068# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATIONS ON STRENGTH AND VIBRATIONS OF ROCKET ENGINES, CHAPTER 3

A. F. Gurov 29 Sep. 1967 31 p Transl. into ENGLISH from the Russian

(AD-675448; FTD-HT-23-747-67) Avail: CFSTI CSCL 13/13

The author writes about investigations and calculations concerning: the supporting power of a double layer cylindrical shell with and without consideration of axial load; the strength reserve of multilayer shells by supporting power, and changes in elasticity modulus of carbon and stainless steels; strength calculation of supporting plates and bottoms; equilibrium equations of a bent plate; bending of a solid plate of constant transverse section; and the calculation of perforated plates. Author (TAB)

N69-11086# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CRITERION OF THE INSTABILITY OF AN ARBITRARY SYSTEM OF DEFLAGRATION IN THE COMBUSTION CHAMBER OF A ROCKET ENGINE WITH SUCCESSIVE AUTOIGNITION OF THE FUEL [KRITERIY NEUSTOYCHIVOSTI PROIZVOL'NOGO REZHIMA DEFLAGRATSII V KAMERE SGORANIYA RAKETNOGO DVIGATELYA S POSLEDOVATEL'NYM SAMOVOSPLAMENENIYEM]
S. K. Aslanov 29 Nov. 1967 8 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 3, 1966 p 85–88
(AD-675234; FTD-HT-23-1047-67) Avail: CFSTI CSCL 21/9.1

A criterion is developed for the evaluation of combustion stability in a liquid rocket engine. TAB

N69-11287# Joint Publications Research Service, Washington, D. C.
COMPARISON OF SINGLE-STAGE AND TWO-STAGE AXIAL AIR MICROTURBINE PERFORMANCE
A. S. Natalevich 14 Oct. 1968 11 p refs Transl. into ENGLISH from Izv. Vyshkh Uchebn. Zavedenii, Aviats. Tekhn. (Kazan, USSR), no. 1, 1968 p 97–104
(JPRS-46658) Avail: CFSTI

No substantial difference in performance characteristics were found when a second stage was added to a single-stage axial microturbine with an outer diameter of somm. Efficiency of the two-stage microturbine was no greater than the single-stage device, with the work of the second stage corresponding to its own losses. The two main factors related to the inefficiency of the second stage are probably the fact that a portion of the kinetic energy is lost from the first stage and that large losses were also caused in the axial gap of the second stage. The construction of a two-stage centripetal or centrifugal microturbine is not considered advisable. M.W.R.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N69-10114 St. Louis Univ., Mo.
VAN ALLEN RADIATION BELT AND ARGUS DIRECTIONAL FLUX DENSITY DISTRIBUTIONS, EXPLORER 4 SATELLITE DATA
Donald Joseph Manson (Ph.D. Thesis) 1967 272 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.50 Order No. 68-1229

Directional radiation flux density distributions from data acquired in the inner Van Allen belt and in the ARGUS Events 1 and 2 shells by the satellite Explorer IV are analyzed and compared with the results of other investigators. Instrumentation, telemetry and data reduction are discussed in detail so that the dissertation can be used as a manual for future Explorer IV data reduction. Space coordinate systems are presented and are related to the measurements necessary to determine the roll (or spin) and tumble motion of the satellite so as to determine its orientation with respect to the earth's magnetic field in space as a function of time. This allows determination of the directional particle flux density relative to the magnetic field. Passes 414 and 427 of the satellite over Huntsville are analyzed in detail as examples of the complete determination of the orientation parameters at a point in space and time from which the subsequent orientation throughout the time of data acquisition can be calculated. Dissert. Abstr.

N69-10124 St. Louis Univ., Mo.
OMNIDIRECTIONAL FLUXES–EXPLORER 4 SATELLITE DATA, ARGUS EVENTS 1 AND 2
John Angelos George (Ph.D. Thesis) 1967 135 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-1220

Two omnidirectional Geiger–Mueller counters flown on Explorer 4, satellite 1958ε, have been used to obtain time histories of electron fluxes resulting from the Argus high-altitude nuclear explosions. Electrons, $E_e > 3$ MeV and $E_e > 7.6$ MeV, were observed in the region $L = 0.69–1.76$ and $L = 2.0–2.25$ for Argus events 1 and 2, respectively. The decay rate of Argus 1 is shown to follow a $t^{-1.13}$ law. Subsequent to the detonation of Argus 2, a broadening of the half-with ΔL by approximately 1.5 is observed in the Argus 1 shell, although the peak count-rate remained at $L = 1.72$, at least within experimental error, during the time of observation. The count-rate ratio of the unshielded to the shielded counter is found to decrease with time, most of the data points clustered about a $t^{-1.13}$ law. This indicates spectral changes with the time in apparent contradiction to earlier results of Jason rocket data. The magnetically disturbed days of September 3–5 had a marked effect (greater than 50% departure from the expected $t^{-1.13}$ law) on the decay rate of Argus 2. Dissert. Abstr.

N69-10153 Cornell Univ., Ithaca, N. Y.
SOME PROBLEMS IN COSMIC GAS DYNAMICS
Robert Chapman Newman (Ph.D. Thesis) 1967 153 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-886

A steady-state, spherically-symmetric, non-viscous, polytropic model of a stellar wind is examined and it is shown that the addition of a shock at the proper distance from the central star allows the solution to fit an arbitrary pressure in the interstellar medium, although for sufficiently large values of this pressure the flow is completely subsonic so that no shock occurs. The more complex equations involving viscosity and heat conduction are solved by a singular perturbation in the transonic region to show that shocks actually do occur and that they become thinner and stronger the farther they are from this region. The effect of a cosmic ray pressure gradient in choking off the solar wind is considered, but it appears that this is not very important. Dissert. Abstr.

N69-10265*# St. John's Univ., Jamaica, N. Y.
THE ENERGY SPECTRA OF ELECTRONS FROM PION–MUON–ELECTRON DECAYS IN INTERSTELLAR SPACE
Joseph H. Scanlon (Ph.D. Thesis) 1964 165 p refs
(Grant NsG-171)
(NASA-CR-97467) Avail: CFSTI CSCL 20H

The energy spectra of electrons resulting from the decay of charged pions in interstellar space via the pion–muon–electron mode were studied. The analysis of the pion–muon–electron decay began in the muon rest frame with the known asymmetric distribution of electrons from muon decay. A Lorentz transformation was made to the pion rest frame, where all directions are related to a fixed set of axes. After the limits on muon direction were determined, the muon momentum and angular dependence were integrated out. A second relativistic transformation gave the electron energy and angular distribution in the frame of the moving pion. A final integration over the electron direction yielded the energy spectra of the electrons. The electron distribution was represented by different mathematical expressions in four distinct regions of pi meson energy which cover the whole range from zero to infinity. The electron distribution function was calculated for 26 values of pion kinetic energy covering a range from 3 mev to more than 110 bev. The peak of the distribution was found to decrease monotonically from 0.31×10^{-1} mev^{-1} at 3 mev to 0.20×10^{-4} mev^{-1} at 112 bev. Author

N69-10278*# Volt Technical Corp., Washington, D. C.
MEASUREMENT OF SCATTERED L_α-EMISSION OF THE SUN IN THE UPPER ATMOSPHERE OF THE EARTH FROM 1000 TO 3500 KM
E. K. Sheffer 4 Nov. 1968 5 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 5, 1968 p 735–737
(Contract NAS5-12487)
(NASA-CR-97455; ST-AI-SF-10768) Avail: CFSTI CSCL 04A

Presented are the results of measurements of the scattered L_α-emission of the Sun in the upper atmosphere of the Earth at altitudes from 1000 to 3500 km during the flight of the spacecraft "VERTICAL SPACE PROBE" in October 1967. An empirical model is constructed for the distribution of neutral hydrogen at these altitudes. Author

N69-10391# Adelaide Univ. (Australia). Dept. of Physics.
OBSERVATIONS OF FINE STRUCTURE IN THE INTERPLANETARY MEDIUM
P. A. Dennison Sep. 1968 17 p refs
(ADP-62) Avail: Issuing Activity

Observations of the interplanetary scintillation of radio sources using spaced receivers enable the size and motion of plasma irregularities in the solar wind to be studied. It has been noted previously that the scale of these irregularities is of the order of the ion gyro-radius in the medium, and in this paper it is shown that the scale increases with distance from the sun. Author

N69-10409 Stanford Univ., Calif.
RADIO FREQUENCY SYNCHROTRON RADIATION FROM ELECTRONS TRAPPED IN THE EARTH'S MAGNETIC FIELD
John Fenwick Vesecky (Ph.D. Thesis) 1967 34 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-17522

It is well known that high energy electrons spiraling along magnetic field lines radiate appreciable power at radio frequencies via the synchrotron process. The basic problem analyzed in the present study is the nature of the radio frequency synchrotron noise, due to electrons in the natural Van Allen belts, that could be observed by a high altitude earth satellite. This problem is considered in terms of radiative transfer, i.e., the transfer of electromagnetic energy from the radiating electrons along a ray path that terminates at the satellite receiver. Estimates of satellite-observed synchrotron emission are made by applying the appropriate solution of the radiative transfer equation to a magnetospheric plasma model based on satellite- and ground-based measurements. It is concluded that synchrotron emission from trapped electrons is strong enough to be observed, except when viewed against the maximum cosmic noise background. Dissert. Abstr.

N69-10616# International Year of the Quiet Sun.
NEUTRON INTENSITIES IN 1964, STATIONS I TO O
Mar. 1968 211 p refs *Its* Cosmic-Ray Intensity During the Intern. Years of the Quiet Sun No. 11
Avail: CFSTI

The data of neutron component obtained at stations in alphabetical order of their names from I to O are presented. The data are listed in the form of natural logarithms of the counting rates in units of 0.1 percent corrected for the barometer effect. The monthly tables include hourly or bi-hourly values according to original data. Daily sum and average are listed for the inspection of the day to day variations. In order to see average shape of the daily variations, the monthly means of hourly or bi-hourly values are given. The monthly means calculated from data in completed days are further analyzed to obtain the first and the second term of harmonic component. Author

N69-10653*# California Univ., Berkeley. Space Sciences Lab.
ENERGETIC ELECTRONS OF TERRESTRIAL ORIGIN BEHIND THE BOW SHOCK AND UPSTREAM IN THE SOLAR WIND
K. A. Anderson 11 Sep. 1968 32 p refs
(Contract NAS5-9077; Grant NGL-05-003-017)
(NASA-CR-97606) Avail: CFSTI CSCL 20H

Energetic electron fluxes associated with the earth's bow shock are found to be present about as often on the dawn side of the sun-earth line as on the dusk side. The peak fluxes in these spikes also show no dawn-dusk asymmetry. Upstream electron events on the other hand are predominantly found to the dawn side of the sun-earth line. Both phenomena have the same temporal character with characteristic times of 30 to 150 seconds. Both have characteristic energies of about 15 KeV but the upstream events are interpreted to be of secondary origin with the bow shock spikes representing the primary acceleration event. This local acceleration process evidently is of no consequence to the problem of the Van Allen belts and auroral processes. Author

N69-10668*# California Univ., Berkeley. Space Sciences Lab.
ELECTRONS AND PROTONS IN LONG-LIVED STEAMS OF ENERGETIC SOLAR PARTICLES
K. A. Anderson Jun. 1968 45 p refs
(Grant NGL-05-003-017)
(NASA-CR-97611) Avail: CFSTI CSCL 20H

In 1966 and 1967 many long-lived streams of low-energy solar electrons and protons were observed near Earth. These streams were sometimes associated with bright flares which occurred many hours earlier and sometimes no individual flare could be found. The long-lived solar events discussed here include energetic storm particles, delayed events and fluxes associated with solar active regions. It is suggested here that these are all probably the same basic phenomena viewed in somewhat different ways depending on the age of the region and its location on the solar disc. These events are usually associated with a depression in the sea-level neutron intensity and one or more sudden commencements or sudden impulses. Both electrons and protons are present in these events but in several cases electrons were not detected. The most unusual feature is that when both particle species are present, the electron flux is centered several hours before the proton flux. Author

N69-10670*# California Univ., Berkeley. Space Sciences Lab.
THE SOLAR PARTICLE EVENTS OF MAY 23 AND MAY 28, 1967
S. T. Lindgren 1 Feb. 1968 55 p refs
(Contracts NAS5-9077, NAS5-9091; Grant NGL-05-003-017)
(NASA-CR-97607) Avail: CFSTI CSCL 20H

McMath plage region 8818 passed over the visible solar disk on May 17–31, 1967. Although it was very active from its first appearance on the eastern limb, no solar particles could be detected near the earth until the evening of May 23, when three bright flares were observed in close succession at 25°–28°E. During the following build-up of the solar particle flux over the 38 hours, the galactic cosmic ray flux > 1 BeV decreased gradually by about 5%. A later particle event early on May 28 was also associated with a bright flare in McMath region 8818, at 33°W. This event displayed a rapid build-up, with electrons arriving first, and an exponential decay. A smooth proton peak, 20 minutes wide, was detected on May 30 closely associated with an SSC attributed to plasma ejection from the parent flare of the May 28 event. Between the geomagnetic storms beginning on May 25 and May 30 an anomalous daily variation was observed in the cosmic ray flux > 1 BeV, the time of maximum falling 7–10 hours earlier than normal. Author

N69-10885*# Geological Survey, Washington, D. C.
REMOTE DETECTION OF SOLAR STIMULATED LUMINESCENCE
William R. Hemphill [1968] 28 p refs
(NASA Order T-65757)
(NASA-CR-97585; NASA-127) Avail: CFSTI CSCL 03B

Preliminary outdoor tests with a high resolution grating spectrometer have established the feasibility of detecting luminescent materials by means of the so-called Fraunhofer line-depth method. This method is advantageous because it uses the sun as an excitation source and is therefore independent of low powered artificial sources such as cathode ray tubes, lasers, and mercury vapor lamps. A Fraunhofer line discriminator suitable for aircraft operation has been built and initial on-the-ground tests are being performed on Rhodamine WT, a luminescent dye used by hydrologists and oceanographers in studies of current dynamics in rivers and estuaries. These tests show that the dye can be detected in 1/2 meter of water in concentrations as low as 5 ppb. Additional ground and aircraft tests are planned to establish the feasibility of using this instrument to detect other luminescent materials such as oil slicks, selected water pollutants, and phosphate rock.
Author

N69-10867*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC STRUCTURE OF SUNSPOT GROUPS WHICH PRODUCE SOLAR PROTON FLARES
Kunitomo Sakurai Sep. 1968 19 p refs
(NASA-TM-X-63383; X-615-68-384) Avail: CFSTI CSCL 03B

Solar proton flares take place due to the release of magnetic energy accumulated within the sunspot magnetic flux tube of force lying in the chromosphere and the lower corona due to the twisting of it, which is seen from the rotational motion of sunspot groups on the photospheric surface. This rotational motion is counterclockwise (clockwise) in the northern (southern) hemisphere when viewed from the earth. The accumulation of magnetic energy within the flux tube due to this motion continues to proceed wntil some instability is induced along the flux tube. It is further shown that the magnetic configuration of sunspot groups is important for the triggering of a solar proton flare.
Author

N69-10904 Polish Academy of Sciences, Lodz.
NEUTRINOS IN SPACE [NEUTRINA WE WSZECHSWIECIE]
Jerzy Jatczak *In its* Progr. in Astronautics 1967 p 7-53 refs
In Polish (See N69-10903 01-30)
Avail: CFSTI

The origin of neutrinos and antineutrinos in stars and distant galaxies is analyzed, including stellar neutrino emission due to nuclear reactions, cosmic particle showers, and interactions of cosmic rays with interplanetary matter and the earth atmosphere. Recombination reactions and the radiochemical cycles responsible for neutrino emission are discussed. The role of neutrinos in the energy levels and balances in stars and in space is examined. Model studies and formulas are presented for pair production and pulsating radiation in space.
Transl. by K.W.

N69-11124# Princeton Univ., N. J. Plasma Physics Lab.
SIMULATION OF THE INTERACTION OF THE SOLAR WIND WITH THE EARTH'S MAGNETIC FIELD
G. G. Managadze and I. M. Podgornyi Aug. 1968 19 p refs
Transl. into ENGLISH from Russian
(Contract AT(30-1)-1238)
(MATT-TRANS-64) Avail: CFSTI

The possibility of simulation of the interaction of the solar wind with the Earth's magnetic field is investigated. Exact simulation of all the processes in the magnetosphere turns out to be unrealizable in practice; however, it is possible to select the parameters of the experiment in such a way that the most interesting cosmic phenomena may be reproduced in the laboratory. Results of experiments with respect to formation of the neutral layer are presented as an example of the accuracy of limited simulation.
Author (NSA)

N69-11136# Osservatorio Astronomico Di Roma (Italy).
SOLAR PHENOMENA, MONTHLY BULLETIN NUMBER 130
Massimo Cimino Oct. 1968 18 p
Avail: Issuing Activity

Tables and diagrams present data on solar phenomena collected at the astronomical observatory in Rome during September and October 1968. Daily total areas of sunspot groups are given for October; and heliographic position, classification, and area of sunspot groups are shown for various times of certain days during September and October. Longitudinal sunspot magnetic fields for various positions are illustrated.
M.W.R.

N69-11264*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
DECREASE IN THE HIGH ENERGY X-RAY FLUX FROM CEN XR-2. SEARCH FOR X-RAYS FROM THE LARGE AND SMALL MAGELLANIC CLOUDS
W. H. G. Lewin, G. W. Clark, and W. B. Smith 1968 10 p refs
(Grant NsG-386; Contract AT (30-1)-2098)
(NASA-CR-97706; CSR-P-68-1) Avail: CFSTI CSCL 20H

Comparative data are presented on the high energy X-ray sky surveys carried out in balloon flights from Mildura, Australia on October 15 and 24, 1967. Tabulations show the energy channel settings, the calculated energy intensity corrected to zero atmospheric thickness, and the ratios of the observed intensities. The comparison shows that the high energy X-ray intensity of Cen XR-2 decreased by approximately 30% between October 15 and 24. No evidence was found of discrete sources in the directions of the large and small magellanic clouds. The upper limits on the X-ray energy flux between 20 and 52 keV from the large and small clouds are $\approx 0.6 \times 10^{-9}$ ergs/cm^2 sec and $\approx 1.2 \times 10^{-9}$ ergs/cm^2 sec. respectively, assuming a spectrum like that of Tau X-1. The upper limits in the 52 to $\approx$110 keV energy range for both clouds are $\approx 10^{-9}$ ergs/cm^2 sec.
M.G.J.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N69-10004 Georgetown Univ., Washington, D. C.
THE TRANSFER OF THERMAL INFRARED RADIATION IN CLOUDY PLANETARY ATMOSPHERES: APPLICATIONS TO VENUS
Robert Earl Samuelson (Ph.D. Thesis) 1967 320 p
Avail: Univ. Microfilms: HC $14.40/Microfilm $4.10 Order No. 67-1691

The principal aims of the present study are: (1) to incorporate thermal emission, absorption, and anisotropic scattering into the theoretical structure of radiative transfer simultaneously and in a general way; (2) to investigate numerically the physical connection between radiation-matter interaction processes on a microscopic scale and the subsequently generated macroscopic radiation field; and (3) to apply the results, where relevant, to the existing thermal infrared observations of Venus. An attempt is made throughout to emphasize those general concepts that are most likely to remain of permanent value. The basic equation of radiative transfer is

derived. The Mie theory for single scattering is incorporated implicitly, and the subsequent derivation allows an unambiguous interpretation of all parameters contained explicitly in the transfer equation; furthermore the derivation allows an assessment of all approximations involved. Dissert. Abstr.

N69-10079 Princeton Univ., N. J.
DEVELOPMENT OF DAYTIME ASTROMETRY TO MEASURE THE GRAVITATIONAL DEFLECTION OF LIGHT
Carl Andrew Zanoni 1967 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 67-9617

Previous attempts at measuring the relativistic deflection of star light in the sun's gravitational field are analyzed. These attempts yield the relativistic light deflection to about 20% accuracy. Possible reasons limiting their accuracy are given. An alternative approach is presented which not only increases the time during which data can be taken but which is less susceptible to systematic errors. A new photoelectric telescope has been specifically designed and is presently being assembled for daytime astrometry near the sun. By using the diameter of the sun as a unit of length, several of the sources of systematic errors present in previous attempts are overcome. Use of Schupmann medial telescope optics provides the means for overcoming the remaining sources of systematic error. This technique should yield the gravitational deflection of light to 1% accuracy. A prototype telescope was built and the results are given. Further applications of this technique and telescope to problems of relativity and astronomy are discussed. Dissert. Abstr.

N69-10085 Princeton Univ., N. J.
PRELIMINARY RESULTS ON THE GRAVITATIONAL FIELD OF THE MOON AND THE PHYSICAL PROPERTIES OF THE MOON AS DETERMINED FROM ANALYSIS OF LUNAR SATELLITE TRACKING DATA
William Herbert Michael, Jr. (Ph.D. Thesis) 1967 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-2503

Tracking data from the first three Lunar Orbiter spacecraft have been analyzed to determine the coefficients in the expansion of the lunar gravitational potential function in terms of spherical harmonics. The basis for analysis of the gravitational components is a special purpose computational approach using numerical techniques and the procedures of differential correction and weighted least squares. A preliminary set of gravitational field coefficients (through fifth degree and fifth order) is presented, and the contributions and possible limitations of this set are discussed. Developments for application of the gravitational field results to determination of various physical properties of the moon are presented. Applications of the results to orbit prediction for lunar satellites, to preliminary determination of moments of inertia of the moon and of the density distribution in the moon, and to calculation of the topography of the moon are discussed. Dissert. Abstr.

N69-10098 Cornell Univ., Ithaca, N. Y.
STELLAR COLLISIONS AND THE EVOLUTION OF ENERGETIC EXTRAGALACTIC OBJECTS
David Spencer DeYoung (Ph.D. Thesis) 1967 209 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-655

The use of stellar collisions as an energy generating mechanism for extragalactic objects is described, and previous work in the area is reviewed. The evolution of stellar clusters which would lead to stellar collisions is then examined. Consideration of the stars as point masses shows that disruptive collisions occur more frequently than coalescing collisions, and it is found that the addition of cold gaseous debris increases this effect. The presence of hot gaseous debris in the later stages of evolution brings the process to a halt, but before this time sufficient energy has been generated to account for the processes observed in extragalactic radio sources. Stellar collisions in one dimension are then considered, with a similarity solution being used for power law density distributions and a constant pressure approximation for the increasing portion of Gaussian and solar distributions. Dissert. Abstr.

N69-10155 Virginia Polytechnic Inst., Blacksburg.
TIME-OPTIMAL RENDEZVOUS FOR ELLIPTIC ORBITS
Kyle Terry Alfriend (Ph.D. Thesis) 1967 126 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-2034)

Presented is a study of the time-optimal rendezvous maneuver when the target vehicle is moving in a known elliptic orbit. The propulsion system of the maneuverable or interceptor vehicle is a multiple engine system which can impart a variable thrust independently in three perpendicular directions. It is assumed that the orientation of the interceptor is such that the directions of the three independent thrust components are: 1) perpendicular to the orbit plane of the target vehicle, 2) along the radius vector from the center of the earth to the target vehicle, and 3) perpendicular to the radius vector from the center of the earth to the target vehicle and in the orbit plane of the target vehicle. Pontryagin's maximum principle is used to find the optimal control law. Use of the maximum principle introduces the adjoint variables for which the initial conditions are unknown. Neustadt's method is used to find these initial conditions. The Fletcher–Powell modification of Davidon's variable metroc method is used to find the maximum of the function. Optimum rendezvous trajectories for various initial conditions, maximum allowable thrust accelerations, and values of the target vehicle eccentricity are presented. Maximum allowable thrust accelerations from 0.25 to 1.0 ft/sec^2 are considered. Orbital eccentricities from 0 to 0.6 are investigated. Dissert. Abstr.

N69-10238# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
POLARIMETRIC AND PHOTOMETRIC SIMULATION OF THE MARTIAN SURFACE
Walter G. Egan Sep. 1968 37 p refs Submitted for publication (RE-342J) Avail: Issuing Activity

An approach is presented to obtain a truly rational interpretation of the Martian surface and atmosphere. Polarimetric and photometric properties of ore specimens (limonite, siderite, desert varnish, and serpentine), considered good prospects for the Martian surface, are presented for the colors B(0.48μ), G(0.54μ), and 1(1.0μ). This data was obtained with a large scale analyzer. Other measurements to define better the specimens are also described. It is concluded that, assuming a small atmospheric influence, the best optical match to the Martian bright areas occurs with Venango County, Pennsylvania, limonite, with a dominant particle size range between 1 and 2mm, and a subsidiary minor distribution of a smaller particle size. The smaller particles are suggested as $< 1\mu$ limonite or $< 37\mu$ siderite. Author

N69-10277*# Pennsylvania State Univ., University Park. Space Science and Engineering Lab.
CATHODOLUMINESCENCE OF ENSTATITE FROM CHONDRITIC AND ACHONDRITIC METEORITES AND ITS SELENOLOGICAL IMPLICATIONS Technical Report, 1 Sep. 1967–1 Jul. 1968
Raymond T. Greer and Jon N. Weber 1 Jul. 1968 142 p refs (Grant NGR-39-009-015)
(NASA-CR-97460; SSEL-16) Avail: CFSTI CSCL 03B

A laboratory study demonstrated the feasibility of obtaining useful correlations of mineral luminescent phenomena. Two monochromator-photomultiplier attachments to an electron microprobe were developed for the study of cathodoluminescence

phenomena on a micron scale. The attachments extend the analytical capabilities of the instrument and facilitate: (1) recording of luminescence spectra; (2) obtaining the distribution of luminescent phases in micro- and bulk specimens; (3) evaluating and recording the relationships between optical fluorescence patterns and conventional X ray analyses of an area scan; (4) studying the effects of electron beam dosages on cathodoluminescence intensity; and (5) relating luminescence intensity to composition within a phase. This information provides a more reasonable basis for interpreting recent observations of lunar luminescence. Under 30 keV electron bombardment, enstatite chondritic and achondritic meteorite specimens were found to display large variation in fluorescence characteristics within what appeared to be homogeneous, single phase material. Author

N69-10278*# National Aeronautics and Space Administration, Washington, D. C.
ORBITS AND REVOLUTIONS
1968 4 p
(NASA FACTS-S-7/3-68) Avail: SOD $0.10 CSCL 22C

Definitions of basic terminology used for orbiting satellites are presented. Formulas for computing sideral and synodic periods for orbits are included, and problems and answers demonstrating the formulas are given. F.O.S.

N69-10299*# Alabama Univ. Research Inst., Huntsville.
DEPLOYMENT OF SPACECRAFT APPENDAGES AND TEMPERATURE CONTROL OF EXPERIMENTS Final Technical Report
R. R. Reed, R. W. Blanton, Jr., and E. V. Wilms Apr. 1968 129 p refs
(Contract NAS8-21110)
(NASA-CR-98066) Avail: CFSTI CSCL 22A

Studies involving actual hardware for experimentation aboard vehicles of the near future were conducted concerning (1) the dynamics and kinematics of appendages necessary for the deployment of experiments, and (2) the thermodynamics and heat transfer aspects of temperature control for the experimental apparatus. The deployment of a solar panel array aboard the ATM vehicle was investigated. A scissor mechanism was selected for this purpose, and the study included conceptual design, dynamic responses, degrees of freedom, natural frequencies, damping, rates of deployment, and maneuvering. The X ray telescope of the ATM vehicle was selected for the temperature control study. Considered were the thermal conductivity of the telescope and supports, location and control of external heaters, nature and location of heat sources and sinks, and environmental conditions. A one-dimensional mathematical model of the telescope was derived, with solar heat input at the exterior end and radiation to the vehicle interior at the other end. A theoretical solution of the model with a radiating boundary condition was solved using a digital computer. K.W.

N69-10331# Wesleyan Univ., Middletown, Conn.
MEASUREMENT OF PARALLAXES AND PROPER MOTIONS Final Report, 1 Jul. 1967–1 Sep. 1968
30 Sep. 1968 5 p refs
(Grant NSF GP-6741)
Avail: Issuing Activity

Progress is reported on evaluation of about 13,000 plates taken with a rotating sector of the 20-inch refracting telescope for the determination of trigonometric parallaxes for star positioning. At the current time 68 parallax series are complete and about 30 plate series covering more than 1000 plates have been measured. Most of the series already measured are of stars taken from the catalogues of Vyssotsky of dwarf M-stars found spectrophotometrically. G.G.

N69-10336*# Houston Univ., Tex. Wave Propagation Labs.
LUNAR TERRAIN AND REFLECTIVITY STUDY Final Report
H. S. Hayre Oct. 1968 261 p refs
(Contract NAS9-6760)
(NASA-CR-92368; TR-68-17) Avail: CFSTI CSCL 22C

A lunar landing trajectory, landing module electronics and radar doppler and altitude beams, and the associated probable landing sites and along-the-trajectory lunar surface were modeled for ultrasonic simulation. The model time was selected to be the real time in this simulation and the model doppler velocity and altitude beam widths were identical to those of the landing module. This objective was achieved by appropriate masking of the 1.0 megacycle (corresponding to 10 GHz radar frequencies) and 0.9 megacycle lead zirconate piston transducers of 1.0 inch diameter. The entire trajectory was divided into three sections: A (altitude 25,000–17,950 feet); B (17,950–3,400 feet); and C (3,400 to 200 feet). The doppler distance and velocity scale factors for these sections were 300, 300, and 78; 6850, 6850 and 1080; and 6×10^3, 6×10^3, 1.56×10^3, respectively. At thirty points along the trajectory radar cross section, data were taken. Author

N69-10383*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN AMBIGUITY IN THE ORBIT DETERMINATION OF PLANETARY FLYBY TRAJECTORIES
W. E. Bollman 1 Nov. 1968 54 p refs
(Contract NAS7-100)
(NASA-CR-97484; JPL-TR-32-1331) Avail: CFSTI: CSCL 22C

Conventional methods of in-flight orbit determination, such as two-way-doppler and range measurements from one or more ground tracking stations, have demonstrated the high accuracy that can be achieved. Traditionally the accuracy of orbit estimation becomes very good near the planet when the spacecraft speeds up under the planet's gravitational attraction and thus as the doppler changes are magnified. The purpose of this study is to analyze the geometrical properties of spacecraft doppler measurements made near a planet and to show that under certain situations an orbit-determination program could converge to an incorrect solution for the planet-centered inclination of the spacecraft hyperbolic orbital plane. Ways of correcting the situation are also presented. Author

N69-10396* Boeing Co., Seattle, Wash.
PHOTOMETRIC PROPERTIES OF SELECTED LUNAR FEATURES
R. W. Shorthill, J. M. Saari, F. E. Baird, and J. R. LeCompte Sep. 1968 699 p refs
(Contract NAS9-7665)
(NASA-CR-92374) Avail: CFSTI CSCL 03A

Brightness versus phase angle curves for 300 selected sites on the moon are presented. Photometric measurements were made with a photomultiplier mounted in a mechanical scanning engine at the focus of one of two large astronomical telescopes. The detector moved across the stationary image of the moon in a rectangular raster, the individual scan lines being separated by a resolution element of about 15 KM diameter at the center of the moon. A complete scan was obtained at each of 23 phase angles approximately evenly spaced through a lunation. Reduction of the data to obtain the photometric phase curves of the 300 sites and the photometric function presented was done by computer. A least square fit of the brightness of each site to the Hapke theoretical model of lunar surface reflection was computerized along with the consequent determination of the parameters contained in the Hapke model which characterize the reflection properties of the lunar surface. Author

N69-10404 Wisconsin Univ., Madison.
LUNAR CONTROL COORDINATES FROM RANGER PHOTOGRAPHY
Paul Richard Wolf (Ph.D. Thesis) 1967 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 67-12495

Analytical photogrammetric procedures are presented for computing control coordinates of points on the surface of the moon. The procedures deal with the photography obtained through the recent Ranger VII, VIII and IX missions. Parameters for each Ranger photograph, which define the camera position and orientation with respect to a moon centered selenocentric coordinate system, were obtained. Camera calibration information for each of the six Ranger cameras was obtained from the same source. The geometric quality of the Ranger photography and of conventional earth aerial photography has been compared and on that basis, estimations of expected errors in computed lunar control coordinates have been made for various stereo pairs of Ranger photographs. Dissert. Abstr.

N69-10425*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
CONSIDERATIONS OF CONDUCTION AND RADIATION ON THE PREABLATION HEATING OF METEOROIDS
Z. Ceplecha and A. Posen 30 Sep. 1968 17 p refs
(Grant NsG-291)
(NASA-CR-97580; SAO Special Rept.-287) Avail: CFSTI CSCL 03B

The equation of heat conduction is solved for the early part of the meteor trajectory of a homogeneous spherical blackbody meteoroid; both radiation and heat conductivity are considered. It is possible to compute the air density at which a given surface temperature of the meteoroid is reached. Author

N69-10431*# IIT Research Inst., Chicago, Ill.
RADIATIVE ENERGY TRANSFER ON ENTRY INTO MARS AND VENUS Quarterly Report, Period Ending Oct. 1968
J. William Helbron Oct. 1968 16 p refs
(Contract NASr-65(01))
(NASA-CR-97622; IITRI-V6048-25; QR-25) Avail: CFSTI CSCL 22A

The integrated absorption has been measured for several strong bands of ethylene, ethane, tetrafluoromethane (carbon tetrafluoride), and sulfur dioxide in the 6 to 8 μ spectral region. The bands were pressure broadened with helium; the absorption was determined from the slopes of Beer's Law plots of observed absorption vs optical density. The values obtained in this study are compared where possible with previous measurements. Author

N69-10432*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
AN ESTIMATE OF THE SOLAR CYCLIC VARIATION OF THE MARTIAN UPPER ATMOSPHERE
D. N. Vachon, D. K. Weidner (NASA, Marshall Space Flight Center), and K. Lichtenfeld Feb. 1968 28 p refs Presented at 2d Conf. on Planetology and Space Mission Planning, N. Y. Acad. of Sci., New York, 26–27 Oct. 1967
(Contract NAS8-22603)
(NASA-CR-97598; Doc.-68SD221) Avail: CFSTI CSCL 03B

A semi-empirical model of the Martian atmosphere is presented. This model is modified by means of an empirical formulation to provide an estimate of probable cyclic variations in the Martian upper atmosphere. The resulting variations are compared to those encountered in the Earth's atmosphere and on this basis appear reasonable. The results indicate that the Martian atmospheric density at 1,000 kilometers during a period of high solar activity is likely to be three orders of magnitude greater than it is during a period of low solar activity. The results therefore suggest that the upper atmosphere density profile inferred from the Mariner IV fly-by experiments is likely to be substantially different from that which will be inferred from the Mars '69 experiments. Author

N69-10470*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
A COMPARISON OF A CLASS OF EARTH-MOON ORBITS WITH A CLASS OF ROTATING KEPLER ORBITS
R. F. Hoelker and B. P. Winston Washington Nov. 1968 65 p refs
(NASA-TN-D-4903) Avail: CFSTI CSCL 22C

In two concurrent series of graphs, a class of orbits in the Earth-Moon (E-M) field and a class of Kepler orbits in rotating coordinates are depicted and compared. A general discussion of characteristics of rotating Kepler orbits is included. The model used for the E-M orbits is that of the restricted problem of three bodies. The orbits of the class depicted originate at the E-M line, half of the E-M distance beyond the moon with velocity orthogonal to the E-M line within the E-M plane. Author

N69-10491 Joint Publications Research Service, Washington, D. C.
ANALYSIS OF THE CHEMICAL COMPOSITION OF THE LUNAR SURFACE BY DIRECT METHODS
B. P. Konstantinov et al 21 Oct. 1968 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk. SSSR (Moscow), v. 181, no. 4, 1968
(JPRS-46715) Avail: CFSTI

Tabulated data are presented on the chemical analysis of the lunar surface conducted by the Surveyor 5 space probe. For comparison, similar data are listed on the content of the most commonly occurring chemical elements in the rocks making up the earth's lithosphere and in stony meteorites. Consideration is given to the elements which are most representative in distinguishing various categories of rocks. Methods for determining the chemical composition of planetary surfaces are compared, and it is concluded that the X-ray spectrographic analysis is rapid and is exceptional in its information yield. An X-ray isotopic fluorescent method for analyzing unprepared surfaces for the basic rock-forming chemical elements is briefly described; the apparatus can be used for speedy chemical analyses of Mars, Venus, and lunar surfaces, and other planetary bodies of the solar system. M.G.J.

N69-10503# National Center for Atmospheric Research, Boulder, Colo.
INFORMATION ON THE GEOMAGNETIC DATA COLLECTED FOR THE LUNAR CURRENT SYSTEM PROJECT
Jagdish Chandra Gupta Sep. 1968 63 p
(NCAR-TN-38) Avail: Issuing Activity

Geomagnetic data were collected for the very high sunspot period of the IGY/IGC between July 1957 and December 1959, as well as for the previous quiet sun period between June 1953 and June 1955. These data, from 99 stations throughout the world, comprise about 950 years of hourly values. Another 600 years of hourly data were acquired on tape for the lunar current system project. Tables summarize H, D, and Z maximum and minimum values at the various stations; and notes are included for modifications on the tape data, data checks, and long time series data. M.W.R.

N69-10526# Royal Aircraft Establishment, Farnborough (England).
THE ORBIT OF INJUN 3 ROCKET (1962 $\beta\tau$ 6) FOR AUGUST TO OCTOBER 1966
Diana W. Scott Nov. 1967 20 p refs
(RAE-TR-67283) Avail: CFSTI

Orbital parameters for 1962 have been obtained at intervals of 3.7 days throughout the period 13 August to 26 October 1966, adding to those already obtained between August 1963 and April 1966. The accuracy of the orbits varies according to the number and geographical distribution of the observations, which totalled 502 and were mainly visual. Average standard deviations for the main parameters are 0.5 sec in the nodal crossing time, 5 m in the semi major axis, 2×10^{-4} in eccentricity, 0.007° in inclination, 0.01° in the longitude of the node, and 0.1° in the argument of perigee. Author

N68-10551# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
STUDIES OF SOUTHERN GALACTIC CLUSTERS. 1: PHOTOELECTRIC PHOTOMETRY OF IC 2391 AND IC 2602
Grahan Hill and Charles L. Perry [1967] 19 p refs Supported in part by NSF
Avail: CFSTI

The results of Hβ, UBV and uvby photometry of possible members of the two galactic clusters IC 2391 and IC 2602 are presented in tabular form. Author

N68-10591*# Lowell Observatory, Flagstaff, Ariz.
PRELIMINARY OBSERVATIONS OF THE JOVIAN 6190A METHANE BAND
Peter B. Boyce 4 Sep. 1968 5 p refs *Its* Bull. 146, Vol. 7, No. 9, p 93–97
(Grant NsG-451)
(NASA-CR-97670) Avail: CFSTI CSCL 03B

Photoelectric spectrum scans of small areas of the Jovian surface were made during the spring of 1968. A computer program computed the equivalent width of the 6190A methane band by comparing the scans to similar scans of the moon. The resulting mean error of a single determination of the equivalent width is 2 percent. The average equivalent width at the center of the disk was 16.9A. However, a day to day variation of up to 2A in the equivalent width was found. The equivalent width also increased with distance from the center of the disk. Author

N68-10592*# Lowell Observatory, Flagstaff, Ariz.
THE ATMOSPHERIC PRESSURE AT THE SURFACE OF MARS, VOLUME 6, NUMBER 12
Karl D. Rakos [1968] 11 p refs *Its* Bull. No. 131 Sponsored by NASA
(NASA-CR-97674) Avail: CFSTI CSCL 03B

Photometric observations of eclipses of Phobos by Mars were carried out by a new photoelectric scanning technique for the purpose of estimating Martian atmospheric pressure on the surface of the planet. An upper limit of 30 mb for the pressure at a mean temperature of 200°K was obtained. The observations show strong evidence of particle absorption at high levels in the atmosphere. The data suggest that the absorption level which causes the so-called blue haze is not higher than 10 km above the surface of the planet. The question as to what value should be adopted for the surface pressure on Mars can be solved by first answering the question as to what distribution of solid particles in the atmosphere is the most probable. Author

N68-10597* McDonnell-Douglas Co., Santa Monica, Calif. Astronautics Div.
STUDY OF DUST DEVILS IN RELATION TO THE MARTIAN YELLOW CLOUDS Interim Progress Report, 1 Feb.–31 Jul. 1968
J. A. Ryan 31 Jul. 1968 34 p
(Contract NASw-1620)
(NASA-CR-97657; IPR-3) Avail: CFSTI CSCL 03B

Work during this reporting period consisted of obtaining additional field data on dust devils, and finishing the computer program for determining temperature lapse rates in the lowermost Martian atmosphere. Five days of good field data were obtained. These have provided several important clues concerning the mechanics of dust devil generation, and have served to verify previous assumptions. Computer runs have shown that the temperature lapse rates in the lowermost Martian atmosphere can become highly superadiabatic, a condition favorable to dust devil generation. Author

N69-10601*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
PHOTOGRAPHIC NETWORKS FOR FIREBALLS
Richard E. McCrosky and Zdenek Ceplecha 4 Oct. 1968 27 p refs
(Grant NGR-09-015-004)
(NASA CR-97623; SAO Special Rept.-288) Avail: CFSTI CSCL 03

The combined results of two photographic networks designed to observe bright meteors (the Prairie Network in the U.S.A. and the All-Sky Network in Czechoslovakia and West Germany) are compared with the expectations for these operations. It is found that the mass flux of fireballs into the earth's atmosphere is greater than anticipated, while the influx of meteorites is apparently less than expected. As a provisional resolution of this anomaly, it is suggested that most of the objects observed are low density fragile meteoroids that undergo nearly complete ablation. A reanalysis of the Příbram meteor data was made, and on this basis we suggest that gross fragmentation of stony meteorites in the high atmosphere may be a common phenomenon. Author

N69-10612# California Inst. of Tech., Pasadena.
WORK DONE IN ASTRONOMY 1967/68
F. Zwicky et al 1968 16 p refs Supported in part by NSF
Avail: Issuing Activity

The extended observations made to check on the photographic magnitudes of galaxies and clusters of galaxies are discussed, along with the selection of the more obvious compact and post-eruptive galaxies for inclusion in a six-volume catalog. Several examples are given to refute the idea that a unique red shift-apparent magnitude relation can be established for the brightest galaxies in clusters. Also presented are findings pertaining to the clusters of compact galaxies, sizes of the rich clusters of galaxies, areas of the sky covered by clusters of galaxies and by galaxies, the covarage of the sky by galaxies, the search for supernovae, photometry and light curves of supernovae, and the spectra of compact and eruptive galaxies. M.G.J.

N69-10641*# Techtran Corp., Glen Burnie, Md.
THE METALLIC PHASE OF METEORITE ROCK [LA PHASE METALLIQUE DES METEORITES PIERREUSES]
R. Caye, R. Giraud, and A. Sandrea Washington NASA Nov. 1968 13 p refs Transl. into ENGLISH from French Presented at Intern. Meeting on Meteorite Res., Vienna, 7–13 Aug. 1968
(Contract NASw-1695)
(NASA-TT-F-11978) Avail: CFSTI CSCL 03B

Several examples are used to extend the elementary identification of peridots and pyroxenes to more precise identification to include opaque ores. The dispersion curve of reflectivity is used to show a narrow interdependence of optical properties and chemical composition, extreme sensitivity of the former to the latter, and in some cases a variance of the chemical composition for a single species within a given meteorite. The method of correlating data from optic reflectometry with chemical factors for ores in the metallic phase of meteorites is shown to be useful even beyond the framework of terrestrial mineralogical problems, as it permits rapid and sure discrimination in certain cases of indeterminants, also

offering a better determination of certain chemical factors without requiring electronic microscopy each time. Author

N69-10648*# Maryland Univ., College Park. Center for Theoretical Physics.
EVIDENCE FOR A CHANGE OF CHEMICAL COMPOSITION OF THE PRIMARY COSMIC RADIATION AND A POSSIBLE CAUSE
J. R. Wayland Sep. 1968 11 p refs
(Grant NGL-21-002-033)
(NASA-CR-97619; TR-891) Avail: CFSTI CSCL 04A

The evidence for a change of the chemical composition of the primary cosmic ray flux at high energies is reviewed. An interpretation using the fluctuation origin of cosmic radiation is given. It is found that there may also be an increase in the total inelastic interaction cross-section at high energies. Author

N69-10669*# New Mexico State Univ., Las Cruces.
JUPITER'S RED SPOT IN 1967–1968
H. Gordon Solberg, Jr. Oct. 1968 10 p ref
(Grants NGL-32-003-001; NGR-32-003-027)
(NASA-CR-97610; TN-701-69-26) Avail: CFSTI CSCL 03B

Photographic observations of Jupiter's Red Spot between 12 September 1967 and 17 July 1968 are reported. As the activity in the SEBs decreased, the Red Spot became larger and darker, finally regaining the prominence it had during early 1966. Author

N69-10682*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CARD FORMAT FOR OPTICAL AND RADAR PLANETARY DATA
Douglas A. O'Handley 1 May 1968 23 p refs
(Contract NAS7-100)
(NASA-CR-97667; JPL-TR-32-1296) Avail: CFSTI CSCL 03A

Informal discussions by users and producers of optical and radar observations of the moon and planets have provided a useful opportunity for the exchange of ideas on such problems as the analysis and interpretation of observations, the discussion of methods, and the presentation of results. One of the results of the discussions was the desirability of a common format for all observational data in machine-readable form. The following report delineates the card formats to be used in the exchange of data. Author

N69-10685*# TRW Systems Group, Redondo Beach, Calif.
COMPARISON OF SOIL EROSION THEORY WITH SCALED LMJET EROSION TESTS
Robert E. Hutton Oct. 1968 163 p refs
(Contract NAS1-7970)
(NASA-CR-66704; TRW-10608-6004-R0-00) Avail: CFSTI CSCL 22A

Predictions, based on an existing theory, of soil erosion caused by impingement of gases from a descending rocket in a vacuum environment have been compared with experimental data obtained in a vacuum sphere. A total of 143 comparisons at various time and surface locations were made which included experiments with varying nozzle, engine, and soil conditions. The experiments were made with a small, cold gas jet which was scaled to represent the Apollo-LM conditions. The comparisons indicated a limited degree of correlation between the theory and the experiments. Author

N69-10705 Wisconsin Univ., Madison.
A RADIAL VELOCITY SURVEY OF HILL REGIONS
Joseph Standard Miller (Ph.D. Thesis) 1967 53 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 67-12454

Radial velocities have been measured for 36 galactic HII regions with the 36-inch cassegrain spectrograph. Distances based on spectroscopic parallaxes of associated stars have been obtained for 31 nebulae from published material, and expected radial velocities have been calculated using these distances and a published kinematical model of the Galaxy. For the 20 nebulae observed in the Orion and Sagittarius spiral arms, the rms difference is 6.0 km/sec, while the nine located in the Perseus arm have an rms difference of 13.1 km/sec. For five nebulae in the Perseus arm the average value of the observed velocity minus the expected velocity is −15.4 km/sec, and observations with the 300-foot radio telescope of the National Radio Astronomy Observatory indicate that there are substantial amounts of neutral hydrogen in the directions of these five nebulae with similar velocities. Dissert. Abstr.

N69-10731# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
FURTHER OBSERVATIONS OF PULSATING RADIO SOURCES AT 13 CM
R. D. Ekers and A. T. Moffet 1968 26 p refs
(Contract N00014-67-A-0094)
(AD-675203) Avail: CFSTI CSCL 3/2

Four pulsars, CP0834, CP0950, CP1133 and CP1919 have been observed at 13 cm with the 210 ft antenna of the J.P.L. Goldstone tracking station. Comparison of the 13 cm intensities with those observed elsewhere at longer wavelengths shows that two have definite cutoffs near 30 cm while one, CP1133 has a power-law spectrum. Pulse shapes are similar to those observed at 74 cm, except that the second component in CP1133 is relatively less intense at 13 cm. Study of individual pulses shows intensity fluctuations with time scales as short as 50 microsec, although the average shape of the pulses is stable. Periods for three pulsars are given with accuracies of 10 to the -8th power to 10 to the -9th power sec, the uncertainties being entirely due to present uncertainties in the source positions. No evidence for any change in period as large as 10 to the -8th power sec has been seen. A position measurement for CP1133 is given. TAB

N69-10745# California Inst. of Tech., Pasadena.
[DISCOVERY, FREQUENCY, AND PHOTOMETRY OF SUPERNOVAE]
F. Zwicky 14 Jun. 1968 15 refs *Its* Circ. Letter No. 9 on Supernovae
Avail: Issuing Activity

A list of supernovae observed at various observatories between 1965 and 1968 is presented. Included are the names of the discoverer and parent galaxy, the date of the discovery, and a brief description of where the supernova appeared. A discussion of the frequency of supernovae and the photometry and light curves of supernovae is also included. S.C.W.

N69-10748# Lowell Observatory, Flagstaff, Ariz.
OBSERVATIONS OF THE STARLIKE OBJECTS 3C 273, 3C 279, 3C 345 AND OF SCO X-1 WITH A SCANNING DUAL BEAM POLARIMETER
Aina Elvius (Uppsala Obs.) 25 Jan. 1968 5 p refs Supported in part by Swed. Nat. Sci Res. Council *Its* Bull. No. 142, Vol. 7, No. 5, p 55–59
Avail: Issuing Activity

Results of observations of polarization characteristics of the quasi-stellar objects 3C 273, 3C 279, and 3C 345; and the X-ray source Sco X-1 which were made using a scanning dual beam polarimeter are reported. S.C.W.

N69-10756*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RESPONSE ENVELOPE: A GLOBAL DESCRIPTION OF THREE-AXIS LARGE ANGLE SPACECRAFT ATTITUDE CONTROL SYSTEMS

George Meyer Washington Nov. 1968 34 p refs

(NASA-TN-D-4896) Avail: CFSTI CSCL 22B

Arbitrary three axis, large angle attitude control systems of highly maneuverable spacecraft capable of tracking time-varying target attitudes are considered. Such systems are inherently multivariable, multidimensional, nonlinear, and nonautonomous with infinite sets of forcing functions and initial conditions. The concept of a response envelope is introduced. It provides an analytical procedure for judging whether a proposed attitude control system of this type is fast enough for the mission of the spacecraft. It is defined as a scalar function of time which at each instant is the maximum possible three-dimensional attitude error between spacecraft and target for any admissible initial condition, time variation of target attitude, and disturbance. A simple procedure is presented for computing the response envelope approximately. The approximation is conservative and may be used as a basis for accepting a proposed system. The procedure is based on the Liapunov theory and a prototype of general attitude control systems. The proposed procedure is illustrated by a numerical example based on an Orbiting Astronomical Observatory. Author

N69-10787*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

CARD FORMAT FOR OPTICAL AND RADAR PLANETARY DATA

Douglas A. O'Handley 1 May 1968 24 p refs

(Contract NAS7-100)

(NASA-CR-97714; JPL-TR-32-1296) Avail: CFSTI CSCL 03A

An attempt is made to provide a format for optical data that will be uniform from 1750 to the present. A separate format is provided for some of the data reconstructed from equations of condition. The card format for planetary range data represents a further attempt to originate a uniform data card for future use. This also includes the possibility of receiving radar echoes from Pluto and other types of radar data. Author

N69-10803*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

CONSTANTS AND RELATED INFORMATION FOR ASTRODYNAMIC CALCULATIONS, 1968

William G. Melbourne, J. Derral Mulholland, William L. Sjogren, Francis M. Sturms, Jr. 15 Jul. 1968 65 p refs

(Contract NAS7-100)

(NASA-CR-97666; JPL-TR-32-1306) Avail: CFSTI CSCL 03A

The principal constants and related information used in space trajectory and navigation calculations are discussed. The values of these constants are described, and estimates of their accuracy are provided. Author

N69-10883*# Volt Information Sciences, Inc., Washington, D. C.

ORIGIN OF SOLAR WIND AND ITS ASTROPHYSICAL ASPECTS

E. R. Mustel' 18 Nov. 1968 38 p refs Transl. into ENGLISH from Astron. Sov. Akad. Nauk SSSR, Nauchn. Inform (Moscow), no. 10, 1968 p 1–38

(Contract NAS5-12487)

(NASA-CR-97740; ST-SP-CR-PF-GM-10772) Avail: CFSTI CSCL 03B

Analysis of general structural properties of the solar corona and of finer structural details of the corona leads to the conclusions that the hypothesis concerning the dipole character of the general solar magnetic field is beset with difficulties; and the gas outflow inside coronal streamers is slower than the outflow from other unperturbed regions. The localization of sources of quasistationary corpuscular streams (QSEC) (QSCS) is discussed. It is pointed out that the subdivision of recurrent magnetic disturbances into two types, the R- and M-disturbances, must be taken into account. A previous conclusion that the main source of QSCS is in the optical-magnetic phase of active regions is confirmed. These streams induce the R-disturbances. The most probable source of M-disturbances is in QSCS originating mainly in the magnetic trailing phase of active regions. Based on the very long duration of geomagnetic disturbances of both types in periods of low solar activity, it is concluded that the QSCS sources are located above the active regions within the solar corona. It is decided that geomagnetic variations are the result of the radiality of QSCS and the annual variation of the geomagnetic axis relative to the sun–earth direction. Author

N69-10903 Polish Academy of Sciences, Lodz.

PROGRESS IN ASTRONAUTICS [POSTEPY ASTRONAUTYKI]

1967 105 p refs In POLISH

Avail: CFSTI

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1. NEUTRINOS IN SPACE J. Jatczak p 7–53 refs (See N69-10904 01-29)

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3. METEOROID SCATTERING IN THE GRAVITATIONAL FIELD OF EARTH AND INFLUENCE ON DISINTEGRATION OF METEORITES ON THE MOON A. S. Wronski p 73–88 refs (See N69-10906 01-30)

4. HUMAN REACTIONS TO STRESS CONDITIONS SIMILAR TO THOSE ENCOUNTERED DURING LONG-DURATION SPACE FLIGHT K. Galubinska p 89-102 refs (See N69-10907 01-05)

N69-10906 Polish Academy of Sciences, Lodz.

METEOROID SCATTERING IN THE GRAVITATIONAL FIELD OF EARTH AND INFLUENCE ON DISINTEGRATION OF METEORITES ON THE MOON [O ROZPRASZANIU METEORYTON W POLU GRAWITACYJNYM ZIEMI I WPLYWIE TEGO ROZPRASZANIA NA ROZKLAD OPADU METEOR YTOW NA KSIEZYCU]

Adam Stanislaw Wronski *In its* Progr. in Astronautics 1967 p 73–88 refs In POLISH (See N69-10903 01-30)

Avail: CFSTI

An analytical study is presented of the density of meteoroid showers based largely on the theory of atomic particle scattering. Special attention is given to the effects of gravitational fields and current sheets. An asymptotic expansion of the Rutherford theory is applied in calculating the scattering of meteoroids in the gravitational fields of the earth and the moon. Transl. by K.W.

N69-10917#

ON THE SPECTRUM OF RELATIVISTIC ELECTRONS ACCELERATED IN COSMIC RAY SOURCES

V. L. Ginzburg and S. I. Syrovatskii [1968] 10 p refs Transl. into ENGLISH from Astrophys. and Space Sci. (USSR), v. 1, 1968 p 451–459

Current thinking regarding the spectrum of relativistic electrons accelerated in cosmic ray sources is reviewed. Domains with strongly developed turbulent gas motion and strong magnetic fields are considered to be cosmic ray sources. In the galaxy such domains are the shells of supernovae and, possibly, the domain of the galactic nucleus. Particle injection is discussed in terms of the statistical acceleration of electrons and protons, and determination is made of the spectrum of electrons injected and accelerated in cosmic ray sources. Under the assumptions made, the spectrum of the escaping electrons agrees with the spectrum of the proton-nucleus component escaping. Continuing particle acceleration within the cosmic ray source is noted. M.W.R.

N69-10993# Sandia Corp., Albuquerque, N. Mex.
EFFECTS OF THE REENTRY ENVIRONMENT ON RADIOISOTOPE HEAT SOURCES
S. McAlees, Jr. Jul. 1968 27 p refs Presented at Nucl. Met. Symp. on Mater. for Radioisotope Heat Sources, Gatlinburg, Tenn.
(Contract AT(29-1)-789)
(SC-DC-68-2161; CONF-681002-1) Avail: CFSTI

The reentry environment for space nuclear systems can be separated into three classes, based upon (1) malfunction of the launch vehicle prior to achieving orbit, (2) orbital decay from a short-lived non-nominal orbit resulting from launch vehicle malfunction during the orbital insertion phase of the mission, and (3) malfunctions of the launch vehicle which result in earth atmospheric entry for lunar or planetary missions. The range of initial velocities and reentry angles is defined for each of the three classes of aborts. The initial reentry conditions, along with the spacecraft configuration resulting from the abort, define the reentry environment to which the nuclear system is exposed. The theoretical and experimental program to define the reentry environment and its effect on the nuclear system is defined and discussed. Materials and design concepts selected to provide intact reentry for a particular SNAP system are described, and results of current studies to predict the response of this system to the reentry environment are presented. Author (NSA)

N69-10998*# Lowell Observatory, Flagstaff, Ariz.
PHOTOELECTRIC OBSERVATIONS OF MARS AND JUPITER WITH A SCANNING POLARIMETER
John S. Hall and Louise A. Riley 16 Aug. 1968 10 p refs /*ts* Bull. 145, Vol. 7, No. 8, p 83–92
(Grant NsG-451)
(NASA-CR-97669) Avail: CFSTI CSCL 03B

The Jupiter observations in this paper have high resolution, and the areas under observation at any time are accurately defined. Although visibility was usually poor and the equipment was not yet operating at its peak performance near the time of opposition of Mars in the spring of 1967, the Mars observations are presented here in order to indicate the advantages of this technique. The polarimeter was used on either of two reflectors. One was the 72-inch Perkins telescope at the Lowell Observatory, the other was a Cassegrain combination of a 30.5 spherical primary and a specially-figured F/32 secondary. This combination was used to produce sharp focal-plane images on the optical axis and stellar images of about one second of arc at a distance of one minute of arc from the optical axis. Scans using a depolarizer have shown very low (less than 0.3%) residual polarization for each telescope in both the ultraviolet and the visual regions. Measures of unpolarized stars at both telescopes have indicated a residual polarization comparable to that to be expected on the basis of the finite number of counts involved. K.W.

N69-11003#
SPECTROMETRIC AND SPECTROPHOTOMETRIC STUDY OF SUNSPOTS
I. Sattarov [1968] 10 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 13, 1968 p 138–147
Avail: CFSTI

Observational and theoretical data on the velocity fields in sunspots are reviewed, and the different results obtained by line shift measurements in the sunspot's core are discussed. Based on this information, it was concluded that the measured line shifts vary with the mean geometric depth of line formation h in a complex way. Subsidence of the material probably occurs in high layers in the spot core ($h < 900$ km), which is retarded with the passage to deeper layers. Starting from $h = 1200$ km deep, a gradually increasing red shift is observed. This shift is apparently due to effects different from the Doppler effect. The line shifts in the penumbra show that the motion of the gas mass increases with passage from the inner to the outer boundary of the penumbra, and reaches the maximum value on the boundary between the penumbra and the photosphere and then decreases abruptly. A comparison of the maximum value of the ray velocity (for the Evershed effect) with the depth h shows that it is more or less constant in the outer layers (up to $h = 1000$ km), and increases with the passage to deeper layers. Author

N69-11067# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE ORBITS OF INTERPLANETARY NAVIGATION, CHAPTER 6
Hsueh-Sen Ch'ien 21 Sep. 1967 31 p Transl. into ENGLISH from the Chinese
(AD-676447; FTD-HT-23-696-67) Avail: CFSTI CSCL 22/3

Hypersonic flow of a perfect gas with a constant adiabatic exponent past a triangular plate with a 20 degree apex angle and blunted leading edges at zero angle of attack is discussed. The simplest two-layer flow pattern is used in analysis to obtain qualitative results, giving a clear picture of interrelations among the flow parameters. Author (TAB)

N69-11074# California Inst. of Tech., Pasadena.
COMPACT GALAXIES AND COMPACT PARTS OF GALAXIES, ERUPTIVE GALAXIES AND POST-ERUPTIVE GALAXIES
F. Zwicky May 1968 9 p Prepared in cooperation with Mount Wilson and Palomar Obs. and Carnegie Inst. of Washington
Avail: Issuing Activity CSCL 03B

Positions are listed for 222 objects classified as compact galaxies, parts of compact galaxies, or eruptive or post-eruptive galaxies. Sixth in a series, this list was issued in May 1968. M.W.R.

N69-11075# California Inst. of Tech., Pasadena.
COMPACT GALAXIES AND COMPACT PARTS OF GALAXIES, ERUPTIVE GALAXIES, AND POST-ERUPTIVE GALAXIES
F. Zwicky Jun. 1968 37 p Prepared in cooperation with Mount Wilson and Palomar Obs. and Carnegie Inst. of Washington
Avail: Issuing Activity CSCL 03B

Positions are listed for 941 objects classified as compact galaxies, parts of compact galaxies, or eruptive or post-eruptive galaxies. Seventh in a series, this list was issued June 1968. M.W.R.

N69-11089*# Bureau of Mines, Minneapolis, Minn. Twin Cities Mining Research Center.
MULTIDISCIPLINARY RESEARCH LEADING TO UTILIZATION OF EXTRATERRESTRIAL RESOURCES Quarterly Status Report, 1 Jul.–1 Oct. 1968
1 Oct. 1968 39 p refs
(NASA Order R-09-040-001)
(NASA-CR-97617) Avail: CFSTI CSCL 22A

Summary data are presented on the 14 research projects being conducted to develop mineral resource technology for supporting manned lunar and planetary missions. The information reported covers surface, thermophysical, strength, and elastic properties of rock in lunar environment; use of explosives in drilling on the moon; thermal fragmentation studies; electrowinning of oxygen from silicate rocks; magnetic and electrostatic properties of minerals in a vacuum; stability of hydrous silicates and oxides in lunar environment; reduction of silicates with carbon; support for underground lunar shelter; and effect of lunar environment of the behavior of fine particles. B.P.

N69-11144*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE RANGER 9 FLIGHT PATH AND ITS DETERMINATION FROM TRACKING DATA
C. J. Vegos, F. Borncamp, A. S. Liu, E. G. Piaggi, D. W. Trask et al 1 Nov. 1968 304 p refs
(Contract NAS7-100)
(NASA-CR-97708; JPL-TR-32-767) Avail: CFSTI CSCL 22C

The current best estimate of the Ranger 9 spacecraft flight path is described, along with the method used to analyze the tracking data. The Deep Space Instrumentation Facility tracking of the spacecraft was virtually continuous from injection to lunar impact. Television photos of the lunar surface were received at the Goldstone Tracking Station during the last 18 min before impacting the moon. The lunar surface that was photographed was the area of the crater Alphonsus. Postflight analysis of the tracking data resulted in valuable determination of the masses of the earth and the moon, tracking station locations, lunar ephemeris scale factor; lunar radius of the Ranger 9 is known to within 0.5 km on the surface of the moon. Author

N69-11153# Royal Aircraft Establishment, Farnborough (England).
ANALYSIS OF THE ORBIT OF O.R.S. 2(1966-51C) IN JANUARY 1967
Diana W. Scott and G. E. Cook Oct. 1967 21 p refs
(RAE-TR-67273) Avail: CFSTI

To provide values of inclination for determining the rotational speed of the upper atmosphere, the orbit of O.R.S. 2 was determined from Minitrack observations made between 10 January 1967 and 18 January 1967. The time residuals of the observations were analysed to investigate variations in atmospheric density. The results show that the density scale height at 195 km had a value of 30±2 km at 10 hour local time in mid-January 1967. Author

N69-11178
RENDEZVOUS PROBLEM FOR GUIDED VEHICLES
N. N. Krasovszii et al [1968] 14 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), no. 4, 1968 p 576–586
Avail: CFSTI

The problem of rendezvous of a tracking and a tracked vehicle is considered. A scheme is presented for constructing the control of the tracking vehicle and a condition is formulated under which the given scheme assures the rendezvous of the vehicles at no later than a definite time. Author

N69-11255*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
THE INSTABILITY OF STELLAR STRUCTURES INTERMEDIATE BETWEEN WHITE DWARFS AND NEUTRON STARS
A. G. W. Cameron and Jeffrey M. Cohen [1968] 14 p refs Sponsored in part by AEC and NSF
(NASA-TM-X-61341) Avail: CFSTI CSCL 03B

It was previously reported that apparent multimillisecond periodicities in pulsar signals may correspond to vibrations of neutron stars. Stellar models in the appropriate density range were reexamined with an improved equation of state, since a period of the order of 10 milliseconds is roughly characteristic of a body with a mean density near 10^{13} gm/cm^3, two orders of magnitude smaller than the mean density of a typical neutron star. It was concluded that the small pulsar frequencies observed were unlikely to be associated with any intermediate stable structure having mean densities around 10^{13} gm/cm^3. B.P.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N69-10193*# ARO, Inc., Arnold Air Force Station, Tenn.
REYNOLDS AND MACH NUMBER SIMULATION OF APOLLO AND GEMINI RE-ENTRY AND COMPARISON WITH FLIGHT
B. J. Griffith and D. E. Boylan *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 21 p refs Supported by Arnold Eng. Develop. Center and NASA (See N69-10186 01-01)
Avail: CFSTI CSCL 22B

Apollo 011 and Gemini 3 spacecraft configurations were investigated in order to resolve several anomalies between preflight predictions and flight data. Attention was focused on simulating the actual Apollo command module (011) and Gemini spacecraft (GT3) "as flown" is model construction over a Mach number range of 3 to 20. The investigation indicated that the influence of the ablator (heat shield) geometry of the Apollo command module causes a significant change in trim angle of attack and resulting decrease in available lift-to-drag ratio. In addition, a very strong viscous influence exists in the initial portion of reentry for both the Apollo and Gemini spacecrafts. The Mach number influence extends up to about Mach 14, which is substantially higher than previous blunt body investigations have indicated. Comparisons of wind tunnel data with existing flight data indicate generally excellent agreement. Author

N69-10224*# Auburn Univ., Ala. Sampled-Data Control Systems Group.
DIGITAL COMPENSATION OF THE THRUST VECTOR CONTROL SYSTEM Technical Report, 28 Sep. 1966–28 Jan. 1967
C. L. Phillips 28 Jan. 1967 87 p refs
(Contract NAS8-11274)
(NASA-CR-98068; TR-7) Avail: CFSTI CSCL 22D

A new approximate technique is given for determining the gain margin in unsampled loops of sampled data control systems. The limitations of this method are discussed and an example is given which compares results obtained using the new technique with those obtained from existing techniques. Some of the problems associated with digitally stabilizing the rate-derived thrust vector control system are discussed, and several alternative solutions of these problems are given. A set of design specifications is established and, by the use of the Nyquist criterion, a digital compensation function is evolved. The performance of the compensation is evaluated analytically at several times throughout the S-1C flight. The effects of quantization in the thrust vector control system are investigated using a simplified system model and a technique based on Liapunov's direct method. The practicality of the technique is discussed and an assessment of its merits is made. A digital computer program is developed to determine the sampled frequency response of the Saturn 5. This program includes the effects of both sloshing and bending dynamics. Author

N69-10295*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ATLAS-CENTAUR AC-12 FLIGHT PERFORMANCE FOR SURVEYOR 3
Washington Nov. 1968 171 p refs
(NASA-TM-X-1678) Avail: CFSTI CSCL 22D

Atlas-Centaur vehicle AC-12, launched on April 17, 1967, was the third operational flight in the Centaur program. The vehicle

carried Surveyor 3, which was boosted into a lunar intercept trajectory by the parking orbit mode of ascent. This mode of ascent included placing the Centaur in a circular orbit, coasting under low gravity conditions, and restarting the Centaur main engines to supply energy to attain the proper lunar-intercept trajectory. This report includes a flight performance evaluation of the Atlas-Centaur launch vehicle system from lift-off through Centaur retromaneuver.
Author

N69-10303*# National Aeronautics and Space Administration, Washington, D. C.
MARINER SPACECRAFT: PLANETARY TRAILBLAZERS
1968 12 p
(NASA Facts-39/2-68) Avail: SOD $0.20 CSCL 22B

A digest is presented on the scientific data obtained by the Mariner 5 survey of Venus, and highlights of other Mariner planetary and interplanetary experiments are reviewed. The major features and instrumentation of the spacecraft are described briefly, along with the techniques used for tracking and data acquisition.
M.G.J.

N69-10318# National Research Council of Canada, Ottawa (Ontario). Space Research Facilities Branch.
BLACK BRANT ROCKET ADD-2-109 LAUNCHED AT CHURCHILL RESEARCH RANGE 22 JANUARY 1968
Jun. 1968 26 p refs
(SREB-012) Avail: Issuing Activity

This report deals with the engineering aspects of preparing the payload and the launching of Black Brant rocket ADD-II-109 into bright visual aurora at night at Churchill Research Range on 22 January 1968. The objectives, which were successfully carried out were the detection of changes in the ambient magnetic field, measurements of the electron spectrum between 40 eV and 10 keV, electron density and temperature levels, ionospheric inhomogeneity and absorption values, and micrometeoroid activity.
Author

N69-10382*# Auburn Univ., Ala. Sampled-Data Control Systems Group.
DIGITAL COMPENSATION OF THE THRUST VECTOR CONTROL SYSTEM Technical Report, 28 May 1966–28 Sep. 1966
C. L. Phillips 28 Sep. 1966 53 p refs
(Contract NAS8-11274)
(NASA-CR-98073; TR-6) Avail: CFSTI CSCL 22D

A plausible explanation is given for the high numerical accuracy often required when z-domain expressions are used to obtain frequency response data for sampled systems. Further, a method is presented for estimating the required computational accuracy for a class of sampled systems. When a digital element is introduced into a system, it is necessary to evaluate the effect on system performance of the resulting representation of some of the system variables by a finite word length. The relative merits of several analytical methods for determining quantization errors are discussed and one of these methods, which is based on Liapunov's direct method, is described in detail. A digital computer program is developed to determine the transfer function from the actuator command signal to the attitude error angle, the roots of the characteristic equation, and the sampled frequency response for the Saturn V.
Author

N69-10392*# Ohio State Univ. Research Foundation, Columbus.
LEAST SQUARES ADJUSTMENT OF SATELLITE OBSERVATIONS FOR SIMULTANEOUS DIRECTIONS OR RANGES. PART 2 OF 3: COMPUTER PROGRAMS
Edward J. Krakiwsky, Jack Ferrier, and Georges Blaha Jan. 1968 122 p refs
(Contract NSR-36-008-033)
(NASA-CR-97465; Rept.-87) Avail: CFSTI CSCL 22C

This report documents the computer programs dealing with the least squares adjustment of satellite observations for simultaneous directions or ranges. The computer programs are based on the theory given in Krakiwsky, Edward J., and Pope, Allen J., Least Squares Adjustment of Satellite Observations for Simultaneous Directions or ranges, Part 1 of 3: Formulation of Equations, Report No. 86 of the Department of Geodetic Science, The Ohio State University, (1967).
Author

N69-10394*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
SPACE ENVIRONMENT CRITERIA GUIDELINES FOR USE IN SPACE VEHICLE DEVELOPMENT (1968 REVISION)
Robert E. Smith, ed. and Don K. Weidner, ed. 31 Oct. 1968 308 p refs Supersedes NASA-TM-X-53521; See N67-29889
(NASA-TM-X-53798; NASA-TM-X-53521) Avail: CFSTI CSCL 22B

This document provides a cross section of space environmental data applicable for use as design criteria guidelines in Marshall Space Flight Center vehicle development programs and advanced studies related to future NASA programs. Extensive use has been made of data from the scientific literature reports generated by and for the NASA and its various field centers, and reports prepared by and for various other government agencies. For more information relating to a specific environmental parameter, the reader should contact the editor.
Author

N69-10455*# Harvard School of Public Health, Boston, Mass. Dept. of Environmental Health Sciences.
STUDY OF SPACE CABIN ATMOSPHERES Semiannual Progress Report, 1 Jan.–30 Jun. 1968
William A. Burgess and Parker C. Reist Oct. 1968 13 p refs
(Grant NGL-22-007-053)
(NASA-CR-97600) Avail: CFSTI CSCL 22B

Aerosol measurements were made in conjunction with a 60-day space cabin simulator test; and investigations were made of a hot-wire droplet sensor, means of optomizing the detector geometry of an aerosol particle analyzer, and the application of laser-holography to aerosol studies. Variations in airborne dust concentration with time were studied in the closed cabin environment, and studies were made of the chemical and physical constituents of the ambient aerosol as well as of the compatibility of several flight instruments. Major emphasis of the hot-wire sensor study was on device calibration and performance characteristics using a water droplet aerosol. Wire temperature was found to affect detector output. Optimum scattering geometries for particle detectors are being developed by computer program, and central dark stop and hollow cone geometries for detectors are illustrated.
M.W.R.

N69-10468*# LTV Aerospace Corp., Dallas, Tex. Missiles and Space Div.
ULTRA-FAST MISSION ANALYSIS ROUTINE FOR APOLLO BLOCK 2 ENVIRONMENTAL CONTROL SYSTEM RADIATORS Final Report
C. W. Hixon, J. E. French, Jr., and H. R. Howell 30 Sep. 1968 118 p refs
(Contract NAS9-6807)
(NASA-CR-92378; Rept.-350.12) Avail: CFSTI CSCL 22B

A computer routine is described for rapid performance predictions of the Apollo Block 2 ECS radiator. Specific equations for a simplified thermal model of the radiators are written directly in the program. A characterization of the flow proportioning valve, bypass valve, and low load heater are included in the routine. Provisions are also included for single panel and redundant system operation. Two lunar orbital and a translunar thermal cycle radiator environments are contained in the routine. Time dependent values may also be input for any radiator environment, inlet temperature and flow rate. The rountine outputs radiator heat rejection, pressure

drop, low load heater on/off operation, flow rate, and outlet fluid temperature at times specified by the user. Computer time required to analyze a 4.08 hour lunar orbit mission (two orbits) with a calculation and print interval of .02 hours is 53 seconds on the Univac 1108 computer. This represents a routine run speed of better than 250 times real time. Author

N69-10469*# Chrysler Corp., Huntsville, Ala. Space Div.
OPTICAL INSTRUMENTATION DATA EVALUATION OF THE SA-204/LM-1 SATURN 1B LAUNCH VEHICLE
L. F. Dennis and W. L. Cardwell
(Contract NAS8-4016)
(NASA-CR-97587; HSM-R302-68) Avail: CFSTI CSCL 22D

This report presents data describing certain phenomena observed from the photo/optical instrumentation of the SA-204/LM-1. This data includes a review of optical coverage and a time history of the sequence of events from vehicle first motion through ignition of the S-4B J-2 engine. Data describing the operation of the umbilical swing arms, the vehicle vertical motion, growth and decay of the retrorocket exhaust pattern, and the S-1B lateral motion during liftoff are also included. The vehicle performance from ignition to loss of view (LOV) was as predicted. The overall camera coverage was excellent. Approximately 93 percent of the cameras produced technically usable film. Author

N69-10494*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LANDING DYNAMICS PROGRAM FOR AXISYMMETRIC IMPACT ATTENUATING VEHICLES (LANDIT)
Albert C. Knoell 15 Nov. 1968 35 p refs
(Contract NAS7-100)
(NASA-CR-97665; JPL-TR-32-1341) Avail: CFSTI CSCL 22B

A computer program (LANDIT) is described that predicts the dynamic landing response characteristics of axisymmetric impact attenuating vehicles consisting of a rigid payload and a crushable impact limiter system. The program is based on the solution of a planar landing dynamics problem considering vehicle impacts against plane unyielding surfaces. Initial conditions that must be provided include impact velocity vector, touchdown angle, vehicle pitch rate, surface slope, and coefficient of friction. Author

N69-10561*# Houston Univ., Tex.
SSV: SATELLITE SERVICING VEHICLES Final Report, 10 Jun.-23 Aug. 1968
R. G. Colwell ed., S. L. Dickerson ed., and A. N. Paul ed. Sep. 1968 355 p refs
(Contract NSR-44-005-059)
(NASA-CR-97483) Avail: CFSTI CSCL 22B

The preliminary system design for satellite servicing vehicles (SSV) is described. Included are concepts, analysis, synthesis, and the evaluation of the proposed SSV. The purposes of the vehicles are to repair, inspect, and service orbiting satellites clustered near a mother space station. The SSV will make between 50 to 100 service trips within the cluster per year. An unmanned vehicle remotely controlled from the space station and a two-man vehicle is proposed from an economic viewpoint. The modular subsystems common to both the unmanned and manned SSV are attached to a common truss framework. These subsystems include three docking booms, two bilateral manipulators, the reaction control system, a fuel cell power supply, communications amplifiers and antenna. The manned SSV has a crew supporting pressure vessel built within the exterior framework. On-site docking will be performed visually by the pilot of this SSV. As an aid to task performance, a half hard suit is provided for one crew member. The manned vehicle is estimated to weigh 2200 pounds empty while the empty robot weighs 1200 pounds. The robot has an indefinite mission time capability, while the manned SSV is limited to 12 hours. Author

N69-10606*# Institute of Modern Languages, Inc., Washington, D. C. Translation and Interpretation Div.
BRIGHTNESS VARIATIONS OF SATELLITES AND THE ROTATION PERIOD OF ECHO 1 [OB IZMENENII BLESKA SPUTNIKOV I PERIODE VRASHCHENIYA EKHO-1]
V. M. Grigorevskiy NASA Nov. 1968 9 p refs Transl. into ENGLISH from Byul. St. Optich. Nablyudeniya Iskusstv. Sputnikov Zemli (USSR), no. 49, 1967 p 9-11
(Contract NASw-1693)
(NASA-TT-F-11936) Avail: CFSTI CSCL 22A

The brightness variations and the period of rotation of Echo 1 are analyzed. The period of Echo 1 is equal to 2 min 03 sec, which coincides exactly with the earlier results. Author

N69-10613*# General Dynamics/Convair, San Diego, Calif.
CRYOGENIC ZERO-GRAVITY PROTOTYPE VENT SYSTEM
J. A. Stark and M. H. Blatt Oct. 1967 121 p refs
(Contract NAS8-20148)
(NASA-CR-98078; GDC-DDB67-008) Avail: CFSTI CSCL 22B

Trade-off and sizing analyses were performed to define the type of heat exchanger, pump drive, optimum vent flow and vent cycle, mixing requirements, and system configuration. Major requirement is for the system to control hydrogen tank pressure to 17 ± 1 psia when the external heating rate is 20 to 30 Btu/hr; design application is for a 14-day mission in an orbital experiment. Hardware and test package specifications are given, along with analytical data on the system vent down characteristics. To prove the feasibility of the heat exchanger vent system, a test program was conducted to determine its operating characteristics under both transient and steady-state conditions. A flight qualification test program is outlined to qualify the zero-g system for use in a manned orbital propellant storage and vent experiment. M.G.J.

N69-10695* Chrysler Corp., Huntsville, Ala. Space Div.
AS-205/CSM-101 LAUNCH VEHICLE DYNAMICS ANALYSES, PART 2
C. L. Colwell, ed. 3 Sep. 1968 143 p refs
(Contract NAS8-4016)
(NASA-CR-97676; TN-AP-68-338-Pt-2) Avail: CFSTI CSCL 22D

Presented are the summary of results and description of detailed trajectory (rigid body) and flight dynamics (flexible body) analyses which are applicable to the Saturn IB launch vehicle for the Apollo-Saturn 205/CSM-101 mission. The documentation is divided into two sections. An integrated summary of conclusions obtained from each analysis, and a collection of technical presentations in each of which are described the study assumptions, mathematical models, analytical approaches and the results obtained. The specific analyses which are included pertain to: (1) liftoff motion, (2) rigid body boost flight wind limits, (3) flexible body flight simulation for real and synthetic winds, (4) H-1 engine out controllability, (5) S-IB/S-4B stage separation relative motion, and (6) auxiliary propulsion system orbital propellant requirements. The data results for the nominal and off nominal vehicle flights are presented in the form of time histories and envelopes of extreme values for significant detailed trajectory and flight dynamics parameters. For flights in which the vehicle is subjected to extreme winds or system malfunctions, there are additional displays in the form of flight limitations imposed by launch pad obstructions, vehicle controllability requirements, vehicle structural integrity, and stage separation clearance distance. Author

N69-10744*# AiResearch Mfg. Co., Los Angeles, Calif.
RESEARCH STUDY ON INSTRUMENT UNIT THERMAL CONDITIONING HEAT SINK CONCEPTS Annual Report
D. W. Graumann and G. R. Woods 2 Jan. 1968 190 p refs
(Contract NAS8-11291)
(NASA-CR-97671; Rept.-67-2577) Avail: CFSTI CSCL 22B

Two concepts which utilize the expendable evaporant approach to heat sink design were developed, the wick-type water boiler and

the porous plate sublimator. Reported are results of an analytical and experimental study designed to develop optimized heat sink modules using these concepts. In the water boiler study, wicking materials were investigated, and water flow distribution and control, heat transport fluid temperature control, and module geometry were analyzed. A multi-wick boiler module and new type of control system were designed, fabricated, and tested. Stacking studies were also performed. On the basis of these studies an optimized one kilowatt wick type boiler was designed. The sublimator study involved an investigation of the performance characteristics of various porous plates during steady state, start-up, restart, and zero heat load operation. Studied were the effects of feed water pressure, steam plenum configuration, and water passage configuration; and the potential use of hydrophobic coatings on porous plates. A multi-module sublimator core was designed, fabricated, and tested. Stacking studies were performed and an optimized one kilowatt sublimator was designed. A second area of interest involved studies of a thermal conditioning panel with a self-contained heat sink. Several thermal panel concepts were studied and the two most promising designs selected for further development. Test modules were designed, fabricated, and tested to substantiate the design procedure and performance predictions. S.C.W.

N69-10746*# National Aeronautics and Space Administration, Washington, D. C.
FUTURE AUTOMATED SPACE MISSION REQUIREMENTS
Edgar M. Cortright 3 May 1967 92 p *Its* NASA News Release
Avail: CFSTI CSCL 22

Performance data, statistics on development cost and times, areas requiring further improvement, and future applications and requirements of spacecraft which depict the balanced mix of automated and manned missions which will characterize the space program of the 1970's are summarized. Considered are scientific satellites, meteorological satellites, communications and technology satellites, lunar probes, and planetary and interplanetary probes. S.C.W.

N69-10775*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL VIBRATION CHARACTERISTICS OF A 1/40-SCALE DYNAMIC MODEL OF THE SATURN 5 LAUNCH UMBILICAL TOWER CONFIGURATION
John J. Catherines Washington Nov. 1968 75 p refs
(NASA-TN-D-4870) Avail: CFSTI CSCL 22D

The results of bending vibration tests on 1/40-scale dynamic models of the Saturn V launch vehicle and its umbilical tower are presented herein. The lateral vibratory response characteristics of these structures, considered separately and as an integral configuration mounted on the launch platform, are presented. Mode shapes, resonant frequencies, and damping values were determined over a frequency range of 10 to 300 hertz (0.25 to 7.5 hertz, full-scale equivalent). The resuls include data for two simulated mass conditions corresponding to a fueled and an unfueled launch vehicle. A description of the models is presented and the scaling concepts employed in their design are discussed. The first four cantilever modes and frequencies of the 1/40-scale models of the vehicle and tower are presented. At its first resonance, the tower responds in planes which are not coincident with its planes of symmetry. The test results for the complete configuration indicate considerable coupling between the launch vehicle and the tower at the higher frequencies, but little coupling at the lower frequencies (below 80 hertz) even though the first cantilever modes of the vehicle and tower were included in this low-frequency range. Author

N69-10780*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE SMALL SCIENTIFIC SATELLITE (S^3) PROGRAM AND ITS FIRST PAYLOAD
D. J. Williams R. A. Hoffman, and G. W. Longanecker Nov. 1968 34 p refs Presented at the 15th Ann. IEEE/GNS Nucl. Sci. Symp., Montreal, Canada, 23–25 Oct. 1968 Submitted for publication
(NASA-TM-X-63386; X-612-68-418) Avail: CFSTI CSCL 22B

The Small Scientific Satellite (S^3) program provides a scientific "bench" which can be used by experimenters for a wide variety of investigations in the magnetosphere and near interplanetary space, employing the Scout launch vehicle. In the conduct of these scientific missions, the S^3 program affords the experimenter control over parameters affecting the investigation, e.g. orbit, attitude control, and orientation. In addition, complete in-flight control of the data format is available through the use of an on-board set of stored program instructions which govern the collection of data and which are reprogrammable via ground command. Many of the spacecraft subsystems are modular and are used according to the experimenter's needs. This paper describes the concept of the S^3 program, the characteristics of the various subsystems, research capabilities of the program, and the first payload as a space nuclear instrumentation system. Author

N69-10785*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LANDING DYNAMICS PROGRAM FOR AXISYMMETRIC IMPACT ATTENUATING VEHICLES (LANDIT)
Albert C. Knoell 15 Nov. 1968 35 p refs
(Contract NAS7-100)
(NASA-CR-97713; JPL-TR-32-1341) Avail: CFSTI CSCL 22B

A computer program (LANDIT) is described that predicts the dynamic landing response characteristics of axisymmetric impact attenuating vehicles consisting of a rigid payload and a crushable impact limiter system. The program is based on the solution of a planar landing dynamics problem considering vehicle impacts against plane unyielding surfaces. Initial conditions that must be provided include impact velocity vector, touchdown angle, vehicle pitch rate, surface slope, and coefficient of friction. Author

N69-10809*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE RANGER 9 FLIGHT PATH AND ITS DETERMINATION FROM TRACKING DATA
C. J. Vegos, F. Borncamp, A. S. Liu, E. G. Poggi, D. W. Trask et al 1 Nov. 1968 303 p refs
(Contract NAS7-100)
(NASA-CR-97712; JPL-TR-32-767) Avail: CFSTI CSCL 22C

This report describes the current best estimate of the *Ranger IX* spacecraft flight path and the method used to analyze the tracking data. Deep Space Instrumentation Facility tracking of the spacecraft was virtually continuous from injection to lunar impact. TV photos of the lunar surface were received at the Goldstone Tracking Station during the last 18 min before impacting the moon. The lunar surface that was photographed was the area of the crater Alphonsus. Postflight analysis of the tracking data resulted in valuable determination of the masses of the earth and the moon, tracking station locations, lunar ephemeris scale factor, and lunar radius of the *Ranger IX* is known to within 0.5 km on the surface of the moon. Author

N69-10832*# International Business Machines Corp., Gaithersburg, Md. Federal Systems Div.
MULTIPROCESSING TECHNIQUES FOR UNMANNED MULTIFUNCTIONAL SATELLITES Final Report
R. A. d'Antonio and H. F. Najjar 6 Sep. 1968 224 p refs
(Contract NAS12-507)
(NASA-CR-86113; FSC-68-1002/3754) Avail: CFSTI CSCL 22B

Analyzed were the subsystems on board a long lived multifunctional satellite in order to determine how multiprocessor could service each subsystem and thus provide increased reliability, flexibility, and eventual degradation for the mission. The computational requirements for servicing the various subsystems linked to the onboard computer system were specified and several multiprocessing configurations were defined in detail and described.

Considered were space, time, and code-division switching principles for an adaptive analog-to-digital converter with flexible sampling rate and quantization precision based on the statistics of the signal. A simulation program was utilized to analyze the performance of the configuration. G.G.

N69-10840*# Chrysler Corp., Huntsville, Ala. Space Div.
AS205/CSM-101 LAUNCH VEHICLE DYNAMICS ANALYSES, PART 2
C. L. Colwell, ed. 8 Jul. 1968 142 p refs
(Contract NAS8-4016)
(NASA-CR-97677; TN-AP-68-338-Pt-2) Avail: CFSTI CSCL 22D

Summary of results and description of detailed trajectory (rigid body) and flight dynamics (flexible body) analyses are presented which are applicable to the Saturn IB launch vehicle for the Apollo–Saturn 205/CSM-101 mission. The analyses describe the study assumptions, mathematical models, analytical approaches and the results obtained, pertaining to: liftoff motion; rigid body boost flight wind limits; flexible body flight simulation for real and synthetic winds; H-1 engine out controllability; S-IB/S-IVB stage separation relative motion; and auxiliary propulsion system orbital propellant requirements. The data results for the nominal and off nominal vehicle flights are presented in the form of time histories and envelopes of extreme values for significant detailed trajectory anf flight dynamics parameters. For flights in which the vehicle is subjected to extreme winds or system malfunctions, there are additional displays in the form of flight limitations imposed by launch pad obstructions, vehicle controllability requirements, vehicle structural integrity, and stage separation clearance distance. Author

N69-10841*# McDonnell-Douglas Co., St. Louis, Mo. Eastern Div.
SOFT LANDER. PART 8: MARS SOFT LANDER CAPSULE STUDY (ENTRY FROM ORBIT)—EFFECT OF NEW ENVIRONMENTS
Washington NASA Sep. 1968 189 p refs
(Contract NAS1-7977)
(NASA-CR-66665-8; G-346) Avail: CFSTI CSCL 22B

The LRC environment (Mars mission model parameters) imposes generally less severe requirements on the capsule than does the VOYAGER environment. The most significant change in capsule design is the reduced surface payload size required for a given mission because the range of surface temperatures allows selection of more efficient lander thermal control systems. The effect of changing to the LRC environment wind and gust criteria is to eliminate some possible radar operation problems and therefore to permit use of a LM (Lunar Module) radar system with fewer modifications than had been indicated previously. There is significant difficulty in simultaneously meeting the requirements imposed by the maximum landing elevation (9 km) and the minimum model atmosphere. Specification of abrupt slope changes, such as presented by surface ridges and peaks, and slope lengths would have contributed to the landing system analysis. Probability distributions of surface winds and atmospheric parameters similar to that presented for surface slope could be used in a statistical analysis of design requirements and permit generation of a more refined design, although this is more important to detailed design than to the present study. Author

N69-10869*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Advanced Programs, Research and Development Div.
A NEW CONCEPT FOR CONTROLLED LIFTING ENTRY FLIGHT EXPERIMENTS
R. L. Nelson, D. A. Price, and F. H. Delpino 13 Apr. 1967 211 p refs
(Contract NAS1-6740)
(NASA-CR-66718; LMSC-677802) Avail: CFSTI CSCL 22B

The report considers the feasibility of a guidance and control concept to provide trajectory control for a lifting configuration with roll modulation. Roll control is obtained without reaction controls or aerodynamic flaps by incorporating a motor driven moveable weight (control mass). Hardware components required include a longitudinal accelerometer, two visible light horizon sensors, a roll rate gyro, and guidance electronics. Entry is assumed to occur after separating from a spinning, inertially stable, burned out rocket motor at an altitude above the sensible atmosphere. Results of the study indicate: (1) the guidance and control concept provides trajectory control that enables simulation of manned lifting entry corridor environments; (2) the systems can be packaged in small scale spacecraft; (3) the spacecraft can be boosted to a velocity in excess of circular orbit speed with a boost vehicle such as Scout; (4) the spacecraft can be despun from an entry spin rate of 3 cps utilizing the control mass as the despin mechanism. Author

N69-10883*# Volt Information Sciences, Inc., Washington, D. C.
ON THE PATH TO ORBITAL STATIONS
20 Nov. 1968 3 p Transl. into ENGLISH from Pravda (Moscow), 17 Nov. 1968
(Contract NAS5-12487)
(NASA-CR-97739; ST-PR-10774) Avail: CFSTI CSCL 22A

Highlights of the unmanned Soyuz-2 and manned Soyuz-3 space flights are presented. M.G.J.

N69-10905 Politechnika Lodzka (Poland).
TRANSFORMERS AND GENERATORS WITH TUNNEL-DIODES FOR THE POWERING OF ELECTRONIC EQUIPMENT IN SPACE VEHICLES [PRZEKSZTALTNIKI I PRZETWORNICE NAPIECIA Z DIODAMI TUNELOWYMI DLA ZASILANIA APARATURY ELEKTRONICZNEJ POJAZDOW KOSMICZNYCH]
Bogdan Palczynski *In* Polish Acad. of Sci. Progr. in Astronautics 1967 refs In POLISH (See N69-10903 01-30)
Avail: CFSTI

Construction and operation principles of transformers and generators for space vehicles are outlined, and the requirements for tunnel diodes for use in such equipment are discussed. The basic equations for determining volt-ampere characteristics and the critical values of conductivity and overvoltage are studied. Self-excitation and the time span of vibrations are briefly considered. A comparison of germanium and gallium arsenide diodes shows the GaAs diodes to have properties advantageous for space application. Transl. by K.W.

N69-10934*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VIBRATION ANALYSIS OF A 1/40-SCALE DYNAMIC MODEL OF SATURN 5 LAUNCH PLATFORM-UMBILICAL TOWER CONFIGURATION
Howard M. Adelman and Earl C. Steeves Washington Nov. 1968 61 p refs
(NASA-TN-D-4871) Avail: CFSTI CSCL 22D

An analysis was performed to determine the lateral-vibrational characteristics of a 1/40-scale dynamic model of the Apollo-Saturn 5 vehicle–umbilical tower configuration. The direct stiffness method was employed for the calculations. The analysis treats the vibration of the complete configuration confined to the plane of the tower and vehicle center lines, although the tower itself was analyzed in two directions. Results are presented for the umbilical tower alone, the vehicle alone, the umbilical tower mounted on the launch platform and the complete vehicle–umbilical tower configuration. The flexible connection between the vehicle and launch platform had to be represented by a rotational spring to obtain good agreement with experiment. All the analytical results were compared with experimental results and the good agreement indicates that the direct stiffness method provides an effective technique for computing the vibrational characteristics of complex structures. Author

N69-10936*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SCIENTIFIC INSTRUMENTS FOR LUNAR EXPLORATION. PART A: LUNAR ORBITER (UNMANNED)
Roy G. Brereton 15 Jan. 1967 28 p refs
(Contract NAS7-100)
(NASA-CR-97673; EPD-472) Avail: CFSTI CSCL 22B

The constraints imposed on the scientific experiments selected for the Lunar Orbiter mission are defined, and a representative list of lunar scientific instruments for these experiments is presented. These include the magnetometer, search coil magnetometer, plasma detector, meteor dust detector, lunar body properties, monostatic radar, gamma ray spectrometer, lunar neutron flux, infrared mapping of the surface, X-ray fluorescence, microwave surface imager, photo-imaging experiment, mass spectrometer, and dosimeter. Also mentioned for consideration are experiments involving radio transmission, a gamma ray or X-ray telescope for studying the occultation of cosmic sources, and ultraviolet instruments for detecting unusual lunar emissions. M.G.J.

N69-11007*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
LATERAL VIBRATION CHARACTERISTICS OF A 1/40-SCALE DYNAMIC MODEL OF APOLLO-SATURN 5 LAUNCH VEHICLE
Earl C. Steeves and John J. Catherines Washington Nov. 1968 45 p refs
(NASA-TN-D-4872) Avail: CFSTI CSCL 22D

Analytical and experimental investigations of the lateral vibration characteristics of a dynamically similar 1/40-scale model of the Apollo-Saturn 5 launch vehicle have been performed. A brief description of the model is given and the procedures used in the tests and reduction of the data are discussed. The idealization of the model and method of analysis are presented. The free-free natural frequencies and corresponding mode shapes are presented for weights corresponding to several flight times including staged configurations. In addition, cantilever results and experimental modal damping values are presented. Good agreement was found between analytical and experimental results; thus the idealization is validated and the beam idealization adequately represents the motion of the model over the frequency range of the investigation. On comparing the frequency of the 1/40-scale model with those of a 1/10-scale replica model, good agreement is found for the first three modes. This comparison indicates that the degree of relaxation of replica scaling used in the design of the 1/40-scale model is acceptable for determining the first three launch-vehicle bending modes. The importance of proper representation of the tie-down condition and the importance of the inclusion of shear deformation are demonstrated. Author

N69-11055*# General Dynamics/Convair, San Diego, Calif.
A MONOGRAPH ON FULL-SCALE DYNAMIC TESTING FOR MODE DETERMINATION
Jan. 1967 62 p refs
(Contract NAS8-11486)
(NASA-CR-98107; GD/C-DDF65-002) Avail: CFSTI CSCL 22D

The concepts, techniques, and problems associated with full scale dynamic test programs of large booster vehicles, both solid and liquid fueled, are presented in a monograph. The discussion considered the measurement of the elastic modes that could affect control system analysis. It included definitions of various excitation systems, suspension systems, mounting systems, instrumentation, data reduction methods, problem areas, and test planning. Coverage of the entire vibration measurement program from test conception through the final test report is presented to aid in conducting successful stability studies in structural dynamics. The disadvantages and advantages of each individual method for task completion are included. B.P.

N69-11090*# General Dynamics/Fort Worth, Tex.
PARAMETRIC STUDY OF OPTIMIZED LIQUID-HYDROGEN THERMAL PROTECTION SYSTEMS FOR NUCLEAR INTERPLANETARY SPACECRAFT. VOLUME 1: RESULTS AND SUMMARY
D. G. Barry and T. S. Hunter 31 Aug. 1968 274 p refs
(Contract NAS8-21080)
(NASA-CR-98111; FZA-434-1) Avail: CFSTI CSCL 22B

A discussion of the results, together with a summary of the important findings of the analytical study of storage of liquid hydrogen propellant for nuclear interplanetary spacecraft is presented. The factors considered were: the basic parameters of Earth orbit staytime, insulation thermal performance, and Mars orbit altitude; the mode of propellant storage; the use of solar shields during Mars transfer and Mars orbit; and orbital tanking. Nonvent, vent partial recondensation, and combination vent-nonvent and partial recondensation-nonvent storage modes were considered. The effects of the above variables upon the stage thermal protection systems and the vehicle initial mass in Earth orbit were determined. The mission is a 1984 conjunction class, manned, Mars stopover with a total duration beyond Earth orbit of 930 days. The vehicle is built up from seven nuclear propulsion and propellant modules and mission payload modules. Optimum propellant storage systems were determined using the thermal protection system optimization computer program. Author

N69-11129 McDonnell-Douglas Co., St. Louis, Mo. Missile and Space Systems Div.
A METHODOLOGY FOR ASSURING THE LIFE OF LONG LIFE SPACECRAFT SYSTEM
E. M. Skinner 15 Feb. 1968 42 p refs
(DAC-62160) Avail: Issuing Activity

A methodology for providing and sustaining spacecraft systems of the required endurance and reliability for long duration manned spacecraft is described. Techniques are included for predicting, enhancing, controlling, and maintaining component and system life during each phase of system development and utilization including those usually applied to provide high reliability spacecraft systems. The need for establishing system life goals early in the system development cycle is demonstrated and the additional techniques required for assuring system life are described. The combination of high reliability, life assurance, and in-flight maintainability techniques provides the frame-work of a plan to ensure system life. Although the plan encompasses the range of effort required, further elaboration will be necessary when it is applied to specific systems. The major handicap in implementing a life assurance plan is the inadequacy of wearout life data for most system components. Methods are suggested for estimating the life of system components when life data is insufficient. Author

N69-11142* Planning Research Corp., Los Angeles, Calif.
ONBOARD CHECKOUT AND DATA MANAGEMENT SYSTEM CONTROL AND DISPLAY UNIT, REVISION A
Richard W. Foster, Leon R. Mittman, and David H. Stomberg 19 Jul. 1967 58 p refs *Its* Tech. Advisement Mem. No. 171-4
(Contract NAS8-20367)
(NASA-CR-98127; PRC-D-1417-Rev-A) Avail: CFSTI CSCL 22B

Results are presented of additional analyses undertaken to identify performance and design criteria for the onboard checkout and data management system (OCDMS) control and display unit (CDU). As an optimal policy shall apply to all man/machine interactions, the initial intent and the operating decisions of man as he works with the OCDMS hardware and software are analyzed to identify the optimum CDU performance and configuration characteristics. Control and display criteria are established by determining in sequence: system objectives, man/machine relationships, console operator qualifications, decision information available, and operator throughput objectives. Having determined these, sufficient justification is assumed for subsequent specification

of: OCDMS display requirements, OCDMS control requirements, display and control hardware elements, and candidate CDU arrangements. Author

N69-11154# Royal Aircraft Establishment, Farnborough (England).
DESIGN AND DEVELOPMENT OF THE ARIEL 3 SATELLITE
Arthur P. MacLaren Sep. 1967 29 p refs Presented at the 2d IFAC Symp. on Autom. Control in Space, Vienna, Sep. 1967
(RAE-TR-67250) Avail: CFSTI

The U.K.3 satellite, now named Ariel 3, is the third satellite to be launched in a co-operative Anglo-American space research programme. Unlike the first two in the series, which were built in U.S.A. to carry British-built experiments, Ariel 3 was designed built and tested in the U.K. It was launched from the U.S. Western Test Range on 5 May 1967. The design of the spacecraft, its structure, mechanisms, power supply and data handling systems are described as well as the five scientific experiments. The latter are designed to measure (1) the vertical distribution of molecular oxygen at about 170 km, (2) electron density and temperature in the upper ionosphere (3) high frequency noise from lightning discharges (4) V.L.F. phenomena (5) galactic radio noise sources. Thermal design and the means used for obtaining attitude information are discussed and preliminary information about its performance in orbit is given. This paper was presented at 2nd IFAC Symposium on Automatic Control in Space, Vienna, September 1967. Author

N69-11252*# General Dynamics/Ft. Worth, Tex.
PARAMETRIC STUDY OF OPTIMIZED LIQUID-HYDROGEN THERMAL PROTECTION SYSTEMS FOR NUCLEAR INTERPLANETARY SPACECRAFT. VOLUME 2: TECHNICAL DETAILS Final Report
D. G. Barry and T. S. Hunter 31 Aug. 1968 98 p refs
(Contract NAS8-21080)
(NASA-CR-98112; FZA-434-2) Avail: CFSTI CSCL 22B

A detailed account is presented of the analytical methods and the computer programs used in this study. A mission analysis, a structural analysis, and a thermal analysis were performed in support of the optimization study for the propellant storage system. In addition the Mars vehicle is described, including the basic nuclear propulsion module, the Mars Excursion Module, and associated mass data required for a complete mass buildup of the vehicle. A discussion of the optimization techniques used in this study covers the basic technique and the computer programs used in the preliminary and final phases. K.W.

N69-11257* General Dynamics/Fort Worth, Tex.
PARAMETRIC STUDY OF OPTIMIZED LIQUID-HYDROGEN THERMAL PROTECTION SYSTEMS FOR NUCLEAR INTERPLANETARY SPACECRAFT. VOLUME 3: NUMERICAL DATA Final Report
D. G. Barry and T. S. Hunter 31 Aug. 1968 643 p
(Contract NAS8-21080)
(NASA-CR-98113; FZA-434-3) Avail: CFSTI CSCL 22B

Numerical data tables presented are the actual computer output of the thermal protection system optimization program for liquid hydrogen storage in nuclear interplanetary spacecraft. Thermal protection data cover insulation thickness, propellant storage system component masses, tank length and area, and propellant loading as well as a mass summary for each of the stages. Total initial stage masses can be summed to obtain the Initial Mass In Earth Orbit (IMIEO). Interplanetary meteoroid shield mass and orbital-assembly interstage mass are also included for 300 different propellant cases. G.G.

N69-11260*# United Aircraft Corp., East Hartford, Conn. Research Labs.
STUDY OF TRAJECTORIES AND UPPER STAGE PROPULSION REQUIREMENTS FOR EXPLORATION OF THE SOLAR SYSTEM. VOLUME 1: SUMMARY
R. V. Ragsac Sep. 1967 42 p ref
(Contract NAS2-2928)
(NASA-CR-73254; F-910352-13-Vol-1) Avail: CFSTI CSCL 22

A computer program was developed for optimizing trajectories and electric propulsion systems of power-limited interplanetary vehicles. Related to this program is a single-coast, constant thrust trajectory optimization program that was recently improved to include a simplified optimization procedure and an expanded payload fraction definition. This modified program can only handle rendezvous trajectories, but is of use in cases where only one coast period is needed and can provide a better definition of the powerplant, thrustor, and inert structure mass effects. The hybrid-thrust mass optimization program utilized data from the above two programs to optimize the combination of high and low thrust. Graphs are included that give optimum exhaust velocity and powerplant fraction and the resulting maximum payload fraction; prime advantage of these charts lies in the speed with which estimates may be made of electric system performance. Equations are included for the incremental velocity of a low thrust system undergoing a planetocentric spiral, velocity and position offset, high thrust planetocentric departure or arrival, and low thrust departure on a hyperbolic trajectory. M.W.R.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N69-10013 Maryland Univ., College Park.
AN ANALYSIS OF THE SPLIT HOPKINSON PRESSURE BAR
James Leland Rand (Ph.D. Thesis) 1967 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-532

The purpose of this paper is to analyze in detail many of the assumptions and techniques often employed to obtain stress-strain relations at rates of strain of approximately $10^3 sec^{-1}$. In particular, the measurement of propagation velocities of finite amplitude strains in long rods has been shown to be an acceptable method for obtaining dynamic stress-strain relations if the material is rate insensitive. In order to demonstrate the validity of this technique, a theory of wave propagation in rate sensitive materials has been developed. The effects of axial wave propagation and interaction detail in short cylindrical specimens on the resulting stress-strain relation have been evaluated in detail. This problem has been solved by the method of characteristics. The solution has been programmed for the automatic computation of these inertial effects which will permit workers in this field to efficiently and accurately evaluate their particular materials of interest. Dissert. Abstr.

N69-10015 California Univ., Berkeley.
A STUDY OF THE DYNAMIC STABILITY OF CONTINUOUS ELASTIC SYSTEMS BY LIAPONOV'S DIRECT METHOD
Raymond Herman Plaut (Ph.D. Thesis) 1967 136 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-137

Liapunov's direct method is used to derive dynamic stability and instability criteria for some elastic and aeroelastic systems.

Domains of asymptotic stability are also obtained. The systems considered are continuous and autonomous, and include columns, arches, plates, and shallow shells. Some nonlinear and nonconservative problems are treated. One-dimensional systems are considered first. The dynamic stability of columns with various end conditions under axial loading is examined. Then necessary and sufficient stability conditions are found for a simply-supported arch and a clamped arch under distributed static loads. The nonconservative problem of a curved panel is an airstream also is investigated and a sufficient condition for stability is established. Two-dimensional systems are studied next. Clamped systems which are investigated include plates and shallow shells under uniform normal forces at the edges. Dissert. Abstr.

N69-10035 Cornell Univ., Ithaca, N. Y.
AN EXPERIMENTAL THREE-DIMENSIONAL ANALYSIS OF RESIDUAL STRESSES AROUND FIBER INCLUSIONS IN EPOXY
James Edward Hill (Ph.D. Thesis) 1967 139 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-658

An experimental method has been employed to determine normal, tangential and interfacial shear stresses around a single stiff fiber inclusion of circular cross-section in an epoxy matrix. The residual stresses determined at room temperature result from a high temperature cure of the epoxy and subsequent cooling to room temperature, due to a difference in thermal expansion coefficient between the epoxy matrix and the glass inclusion. The detailed nature of the stresses appears to reflect the Poisson ratio difference between the epoxy and the glass fiber inclusion. The scattered light apparatus includes an argon laser as the monochromatic light source, a sample holder for positioning the model, and a low power microscope with a grid reticule for making visual measurements of stress. The procedure for determining the separation of stresses is presented in depth as well as the reasoning leading to the choice of an average material constant relating birefringence to stress. Dissert. Abstr.

N69-10037 Virginia Polytechnic Inst., Blacksburg.
THE APPLICATION OF THE METHOD OF CHARACTERISTICS IN THREE INDEPENDENT VARIABLES TO THE HYPERVELOCITY IMPACT PROBLEM
Richard Madden (Ph.D. Thesis) 1967 179 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-2059

A new computer program has been developed for the analysis of the initial hydrodynamic phase of hypervelocity impact. The program solves the inviscid non-heat conducting unsteady fluid dynamic equations in cylindrical coordinates utilizing an approach based on the method of characteristics. The program is applicable to the impact of an infinitely long right circular cylinder striking a semi-infinite target of the same material. The projectile is assumed to be traveling parallel to its axis of symmetry and the target is initially at rest. Results are presented in the form of plots of the axial pressure profile at various times, complete pressure and velocity flow fields and also a plot of the location of discontinuities at various times. The plots give an excellent insight into the physical phenomena associated with the impact. The pressure flow fields have been compared and contrasted with the results obtained from an existing hydrodynamic program and the agreement between the approaches is extremely good. Dissert. Abstr.

N69-10040 Missouri Univ., Rolla.
A THEORETICAL INVESTIGATION OF ELASTIC AND VOIGT TRANSIENT SPHERICAL WAVES, AND PLANE THREE-ELEMENT VISCOELASTIC WAVES
Edward Eugene Hornsey (Ph.D. Thesis) 1967 143 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 67-16741

Spherical waves in elastic and Voigt media were investigated. Series solutions for plane waves in a three element viscoelastic medium were obtained. A dual exponential pressure pulse was assumed because it can exhibit significant features of real pressure pulses while avoiding instantaneous rise time, which is an objectionable feature of some of the models frequently employed in the literature. It was concluded that elastic and Voigt spherical waves, and three element viscoelastic plane waves are not sufficient to represent explosive generated waves in rock. On the basis of this and other investigations cited in the literature it appears that a mechanism for attenuation other than, or in addition to, viscosity will be needed to satisfactorily represent waves in rock. Dissert. Abstr.

N69-10041 Texas A&M Univ., College Station.
MATRIX ANALYSIS OF BEAMS ON DISCRETE, NON-LINEAR ELASTIC SUPPORTS
Aylmer Pao-sheng Cheng (Ph.D. Thesis) 1967 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 67-16451

A matrix method of analyzing beams on discrete, non-linear elastic supports is presented. This approach relates the boundary conditions at the left end of the beam to that at the right end as a function of the beam properties, spring characteristics, and loading conditions. Determination of the conditions at the two ends of the beam permits subsequent solution of the whole beam by successive implementation of the transfer matrix technique. Example problems and design graphs are presented. A computer program was developed for the solution of problems by this method. Dissert. Abstr.

N69-10057*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SHOCK-WAVE PRESSURE DECAY IN POLYCARBONATE TARGETS IMPACTED BY CYLINDRICAL POLYCARBONATE PROJECTILES
John D. Di Battista Washington Nov. 1968 21 p refs
(NASA-TN-D-4864) Avail: CFSTI CSCL 20K

The shock wave pressure decay along the impact axis has been obtained as a function of the shock wave depth in polycarbonate targets, impacted at 6.4 and 7.4 km/sec, with cylindrical polycarbonate projectiles having fineness ratios of 0.715. The shock wave pressure as a function of the shock wave depth was obtained by impacting various thickness targets with similar projectiles. Either the projectile velocity or the maximum spray velocity emanating from the target rear surface was used to obtain the compressed target material particle velocity at the target rear surface just prior to the shock wave reflection. The shock wave pressure associated with the compressed material particle velocity was computed by using the second Rankine–Hugoniot jump condition across a shock and a quadratic relation between compressed material particle velocity and shock wave velocity. Experimental data on the transient shock wave phenomena were taken in low sound speed targets which could be impacted at hypervelocities with cylinders of like material using conventional light gas guns. The data presented herein are useful for comparison with results of hydrodynamic numerical calculations. The projectile launching, detecting, and photographing techniques along with target placement used to obtain unskewed cylindrical projectile impacts are fully described. Author

N69-10059 Michigan Univ., Ann Arbor.
THE CYLINDRICAL SHELL OF FINITE LENGTH UNDER A NEARLY UNIFORM RADIAL IMPULSE

Edward George Lovell (Ph.D. Thesis) 1967 58 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-17810

The shell considered is thin-walled, having a circular cross section and an arbitrary length. Boundary supports permit radial and circumferential displacements while requiring the slope in the longitudinal direction and the axial displacement to vanish at the ends. The material is linear and elastic. Under a uniform radial impulsive loading, this shell responds with simple harmonic radial motion, independent of circumferential and axial location. The principal issue of the investigation is the stability of this motion. The strain measures are nonlinear functions of midsurface displacements and displacement gradients. The longitudinal, circumferential and radial displacements are taken as double Fourier series satisfying the boundary conditions. Lagrange equations are developed for the time-dependent coefficients of the series after the energy has been expressed in terms of them. The result is an infinite set of second order, coupled, nonlinear differential equations. The initial conditions consist of the uniform radial impulse with a superimposed spatial perturbation. Dissert. Abstr.

N69-10062 California Univ., Los Angeles.
A HYDRODYNAMIC MODEL FOR HYPERVELOCITY IMPACT
Karl George Ludloff (Ph.D. Thesis) 1967 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-247

A very rough model describing the mechanics of hypervelocity impact has been analyzed, by means of which the main impact parameters can be computed. The crater depth in "thick" targets, the impact time, and the "cumulative" kinetic energy of the ejecta from the crater, have been derived from the principles of mechanics. The conditions have been characterized by energy and momentum considerations, based on the concept of apparent mass, which has been somewhat overextended beyond the original domain of validity. The inaccuracies resulting therefrom are compensated by applying an additional integral condition, i.e., an overall condition taken from experiment. Particular attention has been paid to the conservation or nonconservation of energy during the passage of the projectile through the target. Dissert. Abstr.

N69-10063 Stanford Univ., Calif.
A STATISTICAL INVESTIGATION OF CLEAVAGE MICROCRACK FORMATION IN POLYCRYSTALLINE IRON
Lloyd Edward Kaechele (Ph.D. Thesis) 1967 214 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 67-17446

Cleavage microcracks form in the grains of low carbon polycrystalline iron tested in tension at low temperatures. These cracks are initiated by cracks in carbide particles at grain boundaries. This study investigates relationships between the formation of cleavage microcracks and macroscopic stresses and strains, by means of statistical techniques. The angle between the tensile axis and the normal to the plane of a crack is an important factor in crack formation, since stress, strain and the available number of cleavage planes are functions of this angle. Microcracks are observed by the surface traces of cracks but the orientation of crack planes cannot be determined from traces. Statistical relationships were developed by which a distribution of crack plane angles can be converted into the distribution of trace angles that will appear on the surface. The converse relationship was also developed, by which an observed distribution of surface trace angles can be converted into the true distribution of crack plane angles, between the pole of cleavage planes and the tensile axis. Dissert. Abstr.

N69-10071 Illinois Univ., Chicago.
MINIMUM WEIGHT DESIGN OF AXIALLY SYMMETRIC SHELLS OF REVOLUTION
Harold Dean Keith (Ph.D. Thesis) 1967 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-1784

A method is developed for determining the shape and thickness of a shell of revolution so that the shell will support a given loading with a minimum of material. In addition the shell may also be required to satisfy an internal volume constraint. The distortion energy per unit volume failure criterion is used to predict failure of the shell. Example problems are solved using membrane theory to predict the distortion energy density throughout the shell. The distortion energy density in the optimum shells is also calculated using a linear bending theory. Comparison of the distortion energies based on the two shell theories indicates that more meaningful designs can be obtained by using a linear bending theory to predict the energy of distortion. A method for numerically integrating the linear system of differential equations with two-point boundary conditions obtained in linear shell theory is also developed. Dissert. Abstr.

N69-10091 Illinois Univ., Urbana.
STRESSES IN THIN CYLINDRICAL SHELLS WITH NON-UNIFORM CIRCUMFERENTIAL LINE LOADS
Claudio Edmondo Todeschini (Ph.D. Thesis) 1967 82 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-1870

Small deflection theory for thin linearly elastic shells based on the Kirchhoff-Love assumption is used as the basis for the governing equations of a long circular cylindrical shell. The equations take the form of two simultaneous fourth order partial differential equations in the radial displacement and a generalized Airy stress function. The problem of the cylinder loaded around a circumference by a non-uniform line load which is self-equilibrating and is applied either radially or tangentially to the shell is analysed by seeking solutions to the governing equations mentioned above for the semi-infinite cylinder $x \geq 0$ free of surface tractions save at the section $x = 0$ where appropriate boundary conditions are specified to ensure geometric continuity and a balance for the external applied forces. Dissert. Abstr.

N69-10092 Virginia Polytechnic Inst., Blacksburg.
THE USE OF A RITZ PROCEDURE IN DETERMINING MINIMUM WEIGHT SHELLS OF REVOLUTION
William Jefferson Stroud (Ph.D. Thesis) 1967 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-2073

A method is presented for calculating the shape and thickness distribution for a minimum weight shell of revolution for given position and slope end conditions and for given proportions of axial load to pressure load. The method makes use of linear membrane theory to relate the loading and shape to stress resultants and uses the strain energy of distortion (von Mises) yield condition to relate the stress resultants to the thickness. Proceeding in this manner, the weight is expressed as an integral which is a function of shape. After the shell shape is written in the form of a series of functions with undetermined coefficients, this weight integral is minimized using a Ritz procedure. Pressure vessels heads are also examined. It is pointed out that a zero curvature boundary condition is inappropriate if one utilizes linear membrane theory and the von Mises yield condition to minimize weight. The specification of position and slope is the required boundary condition. Dissert. Abstr.

N69-10093 Virginia Polytechnic Inst., Blacksburg.
ASYMPTOTIC SOLUTIONS OF A CIRCULAR PLATE PROBLEM
Donald Craig Tolefson (Ph.D. Thesis) 1967 147 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-2075

The rotationally symmetric small and large finite deformations of an annular plate, clamped at its outside edge and containing

a central rigid inclusion to which a normal load is applied, are considered. Perturbation techniques are applied to analyze the first approximations to the Reissner equations for the separate cases of small and large finite deformations. In the case of small finite deformations, where the first approximations to Reissner's equations correspond to the von Karman equations, we examine the limiting cases in infinitesimal and increasingly large deformations. Perturbation expansions in terms of powers of a small parameter are obtained for the dependent variables. Dissert. Abstr.

N69-10117 Kansas Univ., Kansas City.
AN INVESTIGATION OF THE STATIC STABILITY OF CORRUGATED RECTANGULAR PLATES LOADED IN PURE SHEAR
David Eugene McFarland (Ph.D. Thesis) 1967 211 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 68-807

The purpose of this investigation is to study the buckling behavior of a corrugated panel of arbitrary cross-section subjected to in-plane shear loads. Equations are derived which define the buckling load, the buckled shape and the post buckling behavior of this panel. The solution is obtained by replacing the corrugated panel with an equivalent special orthotropic flat plate for which the appropriate material properties are derived. These material properties depend upon the particular corrugated shape and must be derived for a special corrugated plate. It is assumed that this orthotropic plate is acted upon by bending moments, twisting moments and membrane forces. These loads are used to derive a general equation for the potential energy of the system in terms of displacements. From this equation for potential energy, expressions describing the buckling behavior of the plate are developed using techniques of calculus of variations and the Ritz energy method. Dissert. Abstr.

N69-10122 Brown Univ., Providence, R. I.
AN ISOTROPIC FRICTIONAL THEORY FOR A GRANULAR MEDIUM WITH OR WITHOUT COHESION
Jack Ludwig Dais (Ph.D. Thesis) 1967 59 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-1446

The concept of a frictional material as contrasted with a plastic material has been discussed frequently in the technical literature on plasticity. However, the implications of the term frictional have not been developed fully. An isotropic frictional theory is formulated in this thesis, starting with the definition of an isotropic frictional material. In a proper idealization of a granular medium as a frictional material (cohesion may be included), deformation occurs by the smooth sliding of adjacent surface of material points along planes (called slip planes) on which the Coulomb limit condition is reached. The sliding may also be smoothed out over a region so that deformation occurs by a continuous shear along slip planes. In this case the principal axes of stress and strain rate do not coincide, even though the frictional material is isotropic. Author

N69-10148 Virginia Polytechnic Inst., Blacksburg.
ON THE DAMPING OF FLEXURAL PLATE VIBRATIONS BY THE APPLICATION OF VISCOELASTIC LAYERS
Philip Eugene Shelley (Ph.D. Thesis) 1967 62 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-2072

The problem of the damping of flexural vibrations of an elastic plate due to the application of arbitrary viscoelastic layers on either side is solved within the framework of linear first order plate theory. For algebraic simplicity, only one-dimensional motion is considered, and the damping is assumed to be small. The question of dynamic coupling between flexural and extensional motion is resolved and the physical mechanism to which such coupling is due is explained. This insight allows parametric relationships to be determined which will uncouple the problem. The coupling is seen to be a higher order effect which can be neglected within thin plate theory. Dissert. Abstr.

N69-10158 Brown Univ., Providence, R. I.
THERMODYNAMIC AND MECHANICAL CONSIDERATIONS OF AN ASSEMBLAGE OF HOMOGENEOUS ELASTIC-PLASTIC STATES
David Rubin (Ph.D. Thesis) 1967 61 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-1491

The thermodynamics of plastic deformation is considered in terms of an assemblage or continuum of elastic perfectly-plastic elements or states. Such a model can match in considerable detail the external mechanical behavior of real materials and affords a thermodynamic definability. However, a consideration of the internal behavior of any such assemblage or continuum composed of elastic perfectly-plastic materials shows that, in contrast to real materials, the stress-free state has the maximum elastic range. Hardening in the sense of an increasing elastic range is accompanied by a release of stored strain energy and the stress-free state is always restorable. Barriers to continuing deformation are required but they lie outside of the scope of these thermodynamically well-defined assemblages. Dissert. Abstr.

N69-10178 Virginia Polytechnic Inst., Blacksburg.
AN ANALYSIS PROCEDURE CYLINDRICAL AND SPHERICAL SHELLS SUBJECTED TO MULTI-HARMONIC LOADS
David Miles Purdy (Ph.D. Thesis) 1967 97 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-2068

The analysis of shells of revolution subjected to complicated multi-harmonic surface loads is a very complex problem. An analysis procedure is developed to analyze cylindrical and spherical shells of this type. The surface loads of particular interest are the wind loads obtained from model tests in the stability wind tunnel at Virginia Polytechnic Institute. Although designed for use with wind loads the procedure could be applied equally well to any surface load which could be effectively represented by a Fourier series with variable coefficients. The surface loads are expanded into a Fourier series with polynomial coefficients for the cylindrical shell and into spherical harmonics for the spherical shell. The series are truncated after ten terms and give results which fit the wind loads within about 3% for all but a few points. A computer program was written in Fortran IV to develop the loading series and to obtain numerical answers from the solution series. Dissert. Abstr.

N69-10226*# General Electric Co., Philadelphia, Pa.
THEORETICAL PREDICTION OF CRATER SIZE FOR HYPERVELOCITY IMPACT BY REDUCED-DENSITY PARTICLES, 18 MAY 1966–17 AUGUST 1967
T. D. Riney and J. F. Heyda Washington NASA Nov. 1968 109 p refs
(Contract NAS3-8512)
(NASA-CR-1196) Avail: CFSTI CSCL 20K

A theoretical study is presented which predicts the depth of craters produced in a thick aluminum alloy target, AL-2024 T6, when impacted by low density heterogeneous and homogeneous projectiles at velocities of 7.35, 20, and 50 km/sec. The prediction is based on a hydrodynamic model for computing the flow field and a comparison of the computed dynamic pressure with the yield stress of the target for terminating the crater. This indirect method for including the strength effect is first shown to give an accurate prediction of the final crater produced by a normal density aluminum projectile at an impact velocity for which experimental data are available. The criterion is then applied for heterogeneous porous projectiles and homogeneous projectiles of reduced density for velocities in the meteoroid range. Also included is the

development of an improved equation of state for homogeneous reduced density projectiles and the numerical technique, involving linked particle-in-cell and Eulerian finite difference schemes, that was employed for the calculations. Author

N69-10297*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYSIS OF THE AEROELASTIC DIVERGENCE OF TWO EXPERIMENTAL UNGUIDED LAUNCH VEHICLES
Clarence P. Young, Jr. Washington Nov. 1968 30 p refs
(NASA-TN-D-4848) Avail: CFSTI CSCL 20K

A theoretical analysis of two experimental launch vehicles which are known to have failed because of aeroelastic divergence is presented. Data for the analysis and the calculated aeroelastic divergence characteristics are provided. The analytical results and the flight results of the two divergent vehicles are compared. The correlation of the analytical predictions with the actual flight behavior is used for evaluating the method of analysis and to explore further the aeroelastic divergence phenomenon in unguided launch vehicles. Author

N69-10309 New Mexico State Univ., University Park.
A STUDY OF THE FINITE DIFFERENCE APPROXIMATION AS APPLIED TO THE VIBRATION OF UNIFORM BEAMS
Pai-chuin Fang (Ph.D. Thesis) 1967 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 67-17719

The viscously damped beam equation is solved for a family of beams. This family of beams has a common end condition, clamped at the origin; however, the other end may have any one of the free, clamped, hinged, or sliding end conditions. The beams in this family all have similar normal functions and, consequently, have similar solutions. The beams are given an initial displacement by applying a concentrated load at a certain point on the beam and are set in vibration by suddenly removing the load. An analytic solution is determined which yields the displacement as a function of time and distance along the beam. This analytic solution was arrived at by the method of separation of variables. The feasibility of applying finite difference methods to the vibrating beam equation is studied. The results obtained from both solutions show that for engineering purposes the natural frequency associated with the first mode can be applied to a vibrating system with sufficient accuracy. Dissert. Abstr.

N69-10312# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLIED MECHANICS
14 Sep. 1967 27 p refs Transl. into ENGLISH from Prikl. Mekh. (Kiev), v. 1, no. 2, 1965 p 67–73, 110–115
(Contract AF 33(657)-16408)
(FTD-HT-67-342; AD-673812) Avail: CFSTI

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1. BENDING OF A CIRCULAR ORTHOTROPIC PLATE OF VARIABLE THICKNESS N. M. Maslov p 1–9 refs (See N69-10313 01-32)

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N69-10313# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BENDING OF A CIRCULAR ORTHOTROPIC PLATE OF VARIABLE THICKNESS
N. M. Maslov *In its* Appl. Mech. 14 Sep. 1967 p 1–9 refs (See N69-10312 01-32)
Avail: CFSTI

Symmetrical bending of a circular orthotropic plate with an exponential profile is considered. General solutions are obtained for the angular displacement, bending moments, and deflection. Calculation examples that make it possible to ascertain the influence of anistropy on the maximum values of M_r and w_{max} in the case of rigid restraint of the plate's contour are presented. The solutions found by A. D. Kovalenko follow from the solutions found for $n = 1$ and $\beta = +1$, while the solutions given in S. P. Timoshenko's "plates and shells" follow from the solutions found for $n = 1$ and $\alpha = 2$. Author

N69-10378 Illinois Univ., Urbana.
AN EXPERIMENTAL STUDY OF FRETTING CORROSION AND ITS INFLUENCE ON FATIGUE STRENGTH
Donald Henry Rimby (Ph.D. Thesis) 1967 149 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-1839

This thesis is concerned with investigating the effect that several factors associated with fretting corrosion have on the fatigue strength of members simultaneously subjected to fretting action and fluctuating tensile stress. Several factors, considered to be the most important ones in the fretting fatigue problem, were controlled during the investigation. Special fretting fixtures were designed for use in a dynamic test machine. Experimental techniques were developed for measuring and controlling the factors. A rational equation was developed in order to describe the fatigue strength condition of a structural steel subjected to simultaneous fretting action and variable load. A series of experiments were designed and conducted to obtain the numerical data necessary for this equation. Dissert. Abstr.

N69-10389# Aeronautical Research Labs., Melbourne (Australia).
SHEAR TESTS ON CORRUGATED WEBS WITH DISCRETE EDGE ATTACHMENTS
J. D. Holmes Nov. 1966 14 p refs
(ARL/SM-314) Avail: CFSTI

Pure shear tests carried out on straight-sided corrugated webs manufactured from melanex sheet (polyester) are described. Measurements of shear stiffness and buckling loads were made and compared with values obtained from recently published theoretical work. Author

N69-10398 Virginia Polytechnic Inst., Blacksburg.
AN ANALYSIS OF THE PROPULSION CHARACTERISTICS OF A TWO-DIMENSIONAL UNDULATING PLATE IN IDEAL FLOW
Adorjan Gyula Szeless (Ph.D. Thesis) 1967 172 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-2074

The hydroelastic behavior of a two dimensional undulating flexible plate in an incompressible ideal flow is studied with the objective of predicting the propulsive characteristics of the plate. The plate considered is clamped at the leading edge while at the quarter-chord point it is forced to execute a harmonic motion of prescribed amplitude. Two partial differential equations with the associated boundary conditions are to be satisfied, one by the flowing fluid environment and the other by the motion of the undulating plate. Small displacements with respect to the chord length of the plate are assumed resulting in the linearization of Euler's equation of fluid motion. The solution of this equation as applied to an arbitrary waving motion of the plate is taken from previous work and gives the hydrodynamic pressure distribution along the plate in the form of a Fourier series as a function of the plate amplitude. Dissert. Abstr.

N69-10403 Wisconsin Univ., Madison
MULTIPLE SPECIMEN FATIGUE TESTING OF MOLDED THERMOPLASTICS IN BENDING UTILIZING HIGH FREQUENCY PNEUMATIC EXCITATION

Joseph Richard Battenburg (Ph.D. Thesis) 1967 204 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 67-12106

Little information is available on fatigue strengths of small molded high polymers, especially those subjected to stress repetitions in excess of one million cycles. Knowledge concerning such fatigue behavior has important application in several areas of engineering design. The purpose of this investigation was to develop experimental equipment and testing techniques for evaluating fatigue behavior of small plastic specimens and to use these techniques to study some representative types of thermoplastics. A pneumatic fatigue testing machine capable of applying rapid cyclic loading was developed to test, simultaneously, twelve small plastic specimens under controlled temperature conditions. The testing machine derived its operating force from the kinetic energy of streams of high velocity air impinging upon loading disks mounted on the test specimens. Opposing air streams were interrupted by two rotating shutters which pulsated the air stream 180° out of phase. The magnitude of the oscillating force was varied by the pressure in the air supply line. Dissert. Abstr.

N63-10412* West Virginia Univ., Morgantown.
YIELDING ZONES AND THE MECHANISM OF FRACTURE
L. W. Dooley, A. D. Howell, and S. Yusuff [1966] 19 p refs
(Grant NGL-49-001-001)
(NASA-CR-97591) Avail: CFSTI CSCL 20K

A relatively simple theory of yielding and its implication on fracture of relatively brittle materials where the yielding zones attain the same size at failure regardless of crack length is studied. In this paper the experiment and the comparison of the theories with the test data are presented. Twenty inch-wide panels of stainless steel alloy AM 350 (20% CRT) and aluminum alloy 7075-T6 with central saw cuts having length in the range 1–10 in. were tested in tensile loading until maximum load was reached. These measurements showed: (1) that the extent of yielding increases rapidly as failure is approached; (2) that these zones of yielding attain critical size at failure; (3) that with the tests on stainless steel AM 350 (20% CRT) Yusuff's formula is in good agreement and that Anderson's formula forms the lower bound and is conservative; and (4) that the test on Al 7075-T6 specimen confirms the linear relationship. Author

N69-10433# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLIED MECHANICS
18 Sep. 1967 39 p refs Transl. into ENGLISH from Prikl. Mekh. (Kiev), v. 2, no. 9, 1966 p 26–36, 37–43, 124–127
(FTD-HT-67-344; AD-673843) Avail: CFSTI

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1. ELASTIC-PLASTIC EQUILIBRIUM OF SHELLS OF REVOLUTION AT FINITE DEFLECTIONS I. S. Chernyshenko p 1–17 refs (See N69-10434 01-32)

2. AXIAL-COMPRESSION CALCULATION FOR MINIMAL-WEIGHT CYLINDRICAL STRINGER SHELLS A. S. Pal'chevskiy p 18–28 refs (See N69-10435 01-32)

3. OSCILLATIONS OF A SUPERSONIC GAS FLOW IN A CHANNEL OF FINITE LENGTH WITH OSCILLATING WALLS D. A. Derbentsev p 29–34 refs (See N69-10436 01-12)

N69-10434# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELASTIC-PLASTIC EQUILIBRIUM OF SHELLS OF REVOLUTION AT FINITE DEFLECTIONS
I. S. Chernyshenko *In its* Appl. Mech. 18 Sep. 1967 p 1–17 refs (See N69-10433 01-32)
Avail: CFSTI

The elastic-plastic state of strain in arbitrary thin shells of revolution is discussed. The axisymmetric deformations of the middle surface of a shell associated with its normal deflections comparable to the shell thickness, are analyzed, using the geometric relationships for the middle surface and the differential equilibrium equations of an element of the shell in terms of forces as initial equations. The expressions for stress components containing the Il'yushin plasticity function are obtained by using the physical relationships based on the theory of small elastic-plastic deformations. From these expressions and initial equations the resolving differential equations in displacements are obtained, from which a system of two sixth-order nonlinear differential equations is derived. A particular case of determining the stress and strain distributions accompanied by elastic-plastic deformations is discussed. The shell has a circular hole at the top with edges stiffened by a thin elastic ring and is closed by a cover which transmits only the vertical forces to the ring. The finite-difference equations describing the stress and strain distributions in the shell are given, and the results of their numerical solutions are presented in tables and diagrams. Author

N69-10435# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AXIAL COMPRESSION CALCULATOR FOR MINIMAL-WEIGHT CYLINDRICAL STRINGER SHELLS
A. S. Pal'chevskiy *In its* Appl. Mech. 18 Sep. 1967 p 18–28 refs (See N69-10433 01-32)
Avail: CFSTI

A method for designing minimum-weight circular cylindrical shells subjected to axial compression is proposed. The shell under discussion is stiffened by thin-walled stringers of open cross section, hinged along its edges, and the axial compression forces are uniformly distributed along them. The buckling stresses are determined in accordance with the linear theory of small deflections within the range of elastic strain. The maximum value of the ratio $W = N_s/N$, where N_s and N are the buckling forces for stiffened and plain shells, respectively. The following modes of buckling are discussed: 1) the stringers undergo bending and twisting; 2) the stringers are only bent; and 3) the stringers are only twisted. This approach to designing stiffened shells and the formulas for their buckling-stress parameters are taken from I. Ya. Amiro's article and are modified for minimum-weight design. Formulas for N_p, N, and W are derived for modes 1, 2, and 3. The local buckling of stringers is also analyzed and a combination of the skin and stringer parameters is established from which a shell of equal stability against all the above-mentioned modes of buckling can be designed. Author

N69-10452* California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.
FAILURE CRITERIA FOR VISCOELASTIC MATERIALS
Semiannual Status Report, 1 Jan.–30 Sep. 1968
W. G. Knauss Oct. 1968 7 p refs
(Grant NsG-172)
(NASA-CR-97597; GALCIT-SM-68-16) Avail: CFSTI CSCL 20K

Summaries are presented of studies on viscoelastic materials and initial crack growth, crack interactions, and failure mechanisms. Theory and experiment related to crack propagation in a viscoelastic strip is reviewed, as is crack propagation in an unstable manner. Theoretical failure calculations on Solithane 113 in uniaxial tension are currently underway. M.W.R.

N69-10460# North American Rockwell Corp., Thousand Oaks, Calif. Science Center/Aerospace and Systems Group.
ON THE RELATIVISTIC SIMPLE SHEAR OF A SLAB OF NEO-HOOKEAN MATERIAL
George Lianis and Paul J. Blatz (Purdue Univ.) Feb. 1968 33 p refs Submitted for publication
(SC-PP-67-111) Avail: Issuing Activity

The relativistic kinematics of the problem are stated in matrix form, assuming a constant velocity field of light and a two-dimensional infinite slab whose base plane is fixed in an inertial frame. The problem is solved by developing an iteration procedure for pure shear, starting from the classical solution. Treatment of the stress field and the stress boundary conditions is demonstrated. K.W.

N69-10462*# Aztec School of Languages, Inc., Acton, Mass.
FLUTTER OF A CYLINDRICAL SHELL OF ELLIPTICAL CROSS SECTION [FLATTER TSILINDRICHESKOY OBOLOCKHI ELLIPTICHESKOGO SECHENIYA]
L. G. Shandarov Washington NASA Oct. 1968 9 p refs Transl. into ENGLISH from Inzh. Zh. (Moscow), no. 2, 1968 p 122–126
(Contract NASw-1692)
(NASA-TT-F-11977) Avail: CFSTI CSCL 20K

A discussion is given of the dynamic stability of a finite orthotropic elliptic cylindrical shell in a supersonic gas flow, assuming that one of the principal directions of orthotropy of the shell and the velocity vector of the flow coincide with the direction of the shell generatrix. The problem is solved by applying the Ritz method. The flutter parameters and the frequencies of the natural oscillations of a representative shell are calculated on a digital computer as functions of the cross-sectional eccentricity of the shell. Author

N69-10474# Chalmers Univ. of Technology, Goteborg (Sweden). Dept. of Structural Mechanics.
THERMALLY LOADED ELASTIC BEAMS AND PLATES
Bengt A. Akesson Stockholm Roy. Swed. Acad. of Eng. Sci. 1968 34 p refs Acta Polytech. Scand., Civil Eng. and Bldg. Construct. Ser. No. 50
(CI-50) Avail: Issuing Activity

Concepts and terminology of the matrix-formulated analysis of structures composed of finite members are used to clarify and systematize the classical analysis of linearly elastic beams and plates by differential and integral calculus. Differential equations $(EIw'')'' = q$ and $\Delta D \Delta w = q$ for laterally loaded beams and plates are interpreted as displacement method solutions where the role of structure stiffness is played by the differential operators $(d^2/dx^2)EI(d^2/dx^2)$ and $\Delta D \Delta$, and that of structure flexibility by corresponding integral operators. Special attention is paid to systematic treatment of temperature gradient load. Stresses and deflections are calculated. The involved chains of transformations are visualized by use of transformation diagrams. Two numerical examples are given. Author

N69-10513*# Illinois Univ., Urbana. Dept. of Civil Engineering.
NONLINEAR DYNAMIC ANALYSIS OF STRUCTURES Final Report
John. W. Leonard 4 Nov. 1968 33 p refs
(Grant NGR-14-005-107)
(NASA-CR-97573) Avail: CFSTI CSCL 20K

This report summarizes the results of the study of the dynamic response of inflatable shells. The equations of motion were derived for an isotropic inflatable shell with a general configuration and a solution procedure was developed to determine the natural frequencies and modes of free vibrations of shells of revolution with arbitrary meridional contours. A computer program to implement this solution was developed and tested on several sample problems. The forced response of inflatable shells of revolution was studied by means of a modal method of analysis. This general solution technique was tested using the same sample problems used to illustrate the free vibration solution technique. Author

N69-10553# Boeing Scientific Research Labs., Seattle, Wash.
RADIATION FROM AND PANEL RESPONSE TO A SUPERSONIC TURBULENT BOUNDARY LAYER
L. Maestrello Sep. 1968 84 p refs
(D1-82-0719) Avail: Issuing Activity

When the convection velocity of the turbulence exceeds the local speed of sound in the medium, the coupling of the panel modes to the acoustic field becomes very strong. The structural damping which is usually constant for all modes is overshadowed by the acoustic damping which increases with frequency. For a boundary layer of nearly zero pressure gradient the linear theory is still useful in predicting the panel response and compares well with experiment. Using Kirchhoff's theorem the acoustic power radiated from a turbulent boundary layer was expressed in terms of the cross spectral density of the pressure field over a rigid plane surface. Computation shows that by using this method the acoustic power level agrees satisfactorily with the measurement. Author

N69-10554# Johnson (Arne) Ingenieurbuero, Stockholm (Sweden).
SUPPORT BEHAVIOR OF STRESS BENT STATICALLY FIXED AND UNFIXED BEAMS OF ELASTO-PLASTIC MATERIAL: THEORETICAL AND EXPERIMENTAL STUDIES [DAS TRAGVERHALTEN VON BIEGUNGSBEANSPRUCHTEN STATISCH BESTIMMTEN UND UNBESTIMMTEN BALKEN AUS ELASTOPLASTISCHEM MATERIAL—THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN]
Rolf Baehre Stockholm Roy. Swed. Acad. of Eng. Sci. 1968 77 p refs In GERMAN Acta Polytech. Scand., Civil Eng. Build. Construct. Ser. No. 51
(CI-51) Avail: CFSTI

This study is concerned with beams having the dynamic characteristics and deformation properties of aluminum alloys. The tensile range between the proportional limit and the yield value is characterized by progressively elastic behavior. The load capacity of statically determinate and indeterminate systems can be described by means of the extended loading theory; and by using the principle of virtual work, the deformation behavior can be estimated for any given loading rate. In addition to the theory, results are presented of a loading experiment on a single-field beam with a special yield hinge study. The yield hinge effect results from an accumulation of moderate tensile values in a range approximately twice the height of the beam. Transl. by K.W.

N69-10555# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
INFLUENCE OF SPECIMEN GEOMETRY AND STRUCTURE ON THE IMPACT RESISTANCE OF SILICON CARBIDE
J. P. Ashford, and E. K. Priddle May 1968 37 p refs
(RD/B/N-941) Avail: CFSTI

Work to determine the impact resistance of SiC at room temperature and 1000°C is described. Samples of SiC were selected for testing that would fracture according to two different criteria: stored energy, and Hertzian contact stress. The literature is extensively reviewed for impact failure mechanisms, but other appropriate work on SiC was found to be sparse. Equations are developed that describe the main impact resistance criteria, and the influence of microstructure on impact cracking is discussed. Author (NSA)

N69-10556# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
APPLICATION OF FRACTURE MECHANICS TO FATIGUE CRACK GROWTH
C. L. Formby May 1968 11 p refs
(RD/B/N-1050) Avail: CFSTI

Fracture mechanics is applied to Stage 2 crack propagation in fatigue, emphasis being put on the ranges of usefulness of the stress intensity factor, K, in correlating results from different crack

configurations. In repeated tension this simple correlation is valid except when the specimen is very small, when plastic blunting of the crack tip is important, or when the crack is close to instability and the stress high. The stress range over which it can be applied in push-pull fatigue is very limited. A more exact treatment is derived for this, but it can be applied to a few configurations only. The effect on fatigue of pressure vessel bulging is briefly discussed.
Author (NSA)

N69-10560# Southampton Univ. (England). Inst. of Sound and Vibration Research.
PROGRAM FOR THE CALCULATION OF NATURAL FREQUENCIES AND NORMAL MODES OF SKIN-STRINGER PANNEL ARRAYS
Caroline A. Seavey and C. A. Mercer Jul. 1968 41 p refs
(ISUR-TR-6) Avail: Issuing Activity

Details are given for the use of the Fortran program which calculates the natural frequencies and normal modes of a skin stringer panel row. The assembly is assumed to be flat and composed of rectangular sheets of skin separated by stringers. It is supported along the long edges by a pair of frames, but the type of support on the short edges is specified by the user. The skin panels may be of different widths and thicknesses and the stringers may be different. A modified transfer matrix method is used together with frequency searching and iteration routines to find the natural frequencies. For each natural frequency a backsubstitution routine is used to calculate the coefficients leading to the mode shape and moment distribution. To obtain greater numerical accuracy, the individual transfer matrices for each component of the assembly are arranged as submatrices in a large super-matrix. In order to save computer storage space, these submatrices are treated as planes in the super-matrix which is then three dimensional. Author

N69-10638*# Northrop Corp., Hawthorne, Calif. Norair Div.
DEVELOPMENT OF AN ACCELERATED STRESS-CORROSION TEST FOR FERROUS AND NICKEL ALLOYS Final Summary Report, Mar. 1966–Mar. 1968
A. H. Freedman and L. H. Stone Apr. 1968 90 p refs
(Contract NAS8-20333)
(NASA-CR-98120; NOR-68-58) Avail: CFSTI CSCL 11F

A simple, accelerated, laboratory test for evaluating the stress corrosion susceptibility of a ferrous or nickel-base alloy has been developed. Single-edge-notched and fatigue-cracked specimens are tension loaded in a NaCl solution (200gm/liter distilled water), and the threshold stress intensity for stress corrosion (K_{ISCC}) is determined. Identical specimens were tension loaded in racks exposed at the seacoast, and their K_{ISCC} values were measured to act as standards for evaluating the accelerated test. The accelerated test requires a maximum test time of 1000 hours. Test times are one to three orders of magnitude shorter than those required for similar specimens in a seacoast environment. The acceleration of test time is produced by the aggressive corrodent, the presence of a crack, and the plane-strain loading conditions. Twenty of the twenty-three combinations of material, heat treatment, and welding conditions that were tested showed good-to-excellent agreement between the K_{ISCC} values obtained in seacoast and in accelerated tests. Author

N69-10664*# Texas A&M Univ., College Station. Activation Analysis Research Lab.
A STUDY OF THE FEASIBILITY OF FAST NEUTRON ACTIVATION ANALYSIS AS A NONDESTRUCTIVE TESTING METHOD FOR ALPHA PHASE TITANIUM ALLOY Semiannual Report, 1 Jan.–30 Jun. 1968
Richard E. Wainerdi 30 Jun. 1968 6 p
(Grant NGR-44-001-067)
(NASA-CR-97578) Avail: CFSTI CSCL 20K

Neutron activation analyses on heat treated titanium-aluminum-vanadium alloy samples showed a higher concentration of alpha material than in untreated samples. Increased oxygen contents ranged from .36% to 1.3%. To determine the feasibility of neutron collimation for mapping oxygen concentration in titatinum alloy plates, experiments were conducted with polyethylene, lead, and copper as neutron shielding. The use of a focusing lead collimator with a 3" × 3" NaI scintillation detector was then selected for measuring nitrogen-16 activity in a localized region of the flat plate during future research. G.G.

N69-10696 Virginia Polytechnic Inst., Blacksburg.
DAMPING CHARACTERISTICS OF AN AXIAL SLIP JOINT UNDERGOING PARTIAL INTERFACE SLIP
Malcolm Armstrong Cutchins, Sr. (Ph.D. Thesis) 1967 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-2039

An investigation of the damping associated with interface slip in a joint subjected to axial vibrations is conducted. A double-lap joint of stainless steel bars is fixed at one end and subjected to two loads: an oscillating longitudinal load at the opposite end from the support and a uniformly distributed load normal to the bars and clamping them together. The oscillatory load is provided by an electrodynamic shaker and the clamping load is applied statically through the use of weights and steel-backed rubber pads. There is no connection between the members of the joint other than the friction which develops at the joint interfaces. Experimental values of a parameter proportional to the energy dissipation per cycle are determined for a small number of finely ground specimens over a range of several normal and oscillating load values. A total of 38 tests at test frequencies of 500 cps, 1250 cps, and 2250 cps are reported. Dissert. Abstr.

N69-10752*# California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.
DELAYED FRACTURE IN VISCOELASTIC-PLASTIC SOLIDS
Milosz P. Wnuk and Wolfgang G. Knauss Sep. 1968 29 p refs
(Grant NsG-172-60)
(NASA-CR-97562; GALCIT-120; GALCIT-SM-68-8A) Avail: CFSTI CSCL 20K

Using the viscoplasticity model of Crochet, the growth of a penny-shaped crack in a linearly viscoelastic solid was studied in an attempt to elucidate (1) the load carrying ability of glass-like polymers having potential application as structural materials and (2) the fracture behavior of materials possessing relaxation and creep responses which span several decades of time. The Crochet model attempts to generalize the elastic-plastic stress-strain law by replacing the elastic portion by a linearly viscoelastic one and makes the yield stress dependent on the rate of deformation during the initial, linearly viscoelastic deformation phase. Stress and strain distribution around the crack, effect of time dependent yield, and delayed fracture for time-independent yield are evaluated using the prescribed model. Comments on failure behavior in two dimensional stress fields are included. S.C.W.

N69-10868*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
STABILITY CRITERIA FOR A CANTILEVER SUBJECTED TO A TIME-DEPENDENT FOLLOWER FORCE
R. H. Plaut [1968] 10 p refs
(Grant NGL-40-002-015; Contract DA-31-124-ARO(D)-270; Grant AF-AFOSR-893-67)
(NASA-CR-97618) Avail: CFSTI CSCL 20K

We investigate the stability of a nonconservative nonautonomous system, a cantilevered column subjected at its free end to a compressive follower force which varies with time. Viscous damping is assumed to be present. With the use of a

Liapunov type of approach, conditions are obtained which guarantee asymptotic stability or almost sure asymptotic stability of the column. Author

N69-10880# Southampton Univ., (England). Inst. of Sound and Vibration Research.
THIN PANEL FRACTURE SURFACE STRIATIONS FORMED UNDER ACOUSTIC LOADING
G. S. Jost Jul. 1968 43 p refs Sponsored by Commonwealth of Australia Public Serv. Board Scholarship and Min. of Technol.
(ISVR-TR-7; PD/40/040/ADM) Avail: Issuing Activity

Tests were conducted to determine whether the macroscopic striation pattern might yield useful information about the local static stress level of a simple panel with constant applied tensile load subjected to broadband acoustic excitation. The observed basic striation pattern is discussed in terms of the pre- and postbuckled phases, which are characterized by asymmetric and curved aspects, and the buckling phase which is essentially straight and symmetric. It was concluded that the asymmetry and curvature are associated with bending stress, and that the symmetric pattern derives from the substantial, large amplitude alternating stresses. A static fracture mechanics stress analysis was also conducted on the shape of the crack front; the findings suggest that the magnitudes of the bending stresses acting in the cracktip region are substantially modified by any asymmetry of the crack front. Calculations are included on the effect of a partly plastic zone on the position of the neutral axis. M.G.J.

N69-10900# Atlantic Richfield Hanford Co., Richland, Wash.
STUDY OF POLYETHYLENE BOTTLES AS CONTAINERS FOR PLUTONIUM NITRATE
D. A. Hoover and W. P. Ingalls Jun. 1968 25 p refs Presented at the 2nd Intern. Symp. on Packaging and Transportation of Radioact. Mater., Gatlinburg, Tenn.
(Contract AT(45-1)-2130)
(ARH-SA-18; CONF-681001-4) Avail: CFSTI

High density polyethylene bottles have been used for the past two years as primary containers for plutonium nitrate solutions under both transport and storage conditions. During the first six months of use, some concern was evidenced because of leaks at the bottle seal, malfunction of the bottle vents, and stress cracks in the bottles. The results of an R & D program conducted to correct these problem areas are reported. Author (NSA)

N69-10948# City Coll. of the City of New York. Dept. of Mechanical Engineering.
THE DYNAMIC RESPONSE OF FINITE, ELASTIC CYLINDERS ACCORDING TO VARIOUS SHELL THEORIES. VOLUME 1 Interim Technical Report
Selig Fisher and Sherwood B. Menkes Aug. 1968 167 p refs
(Contract DA-31-124-ARO(D)-419)
(AD-675471; CUNY-TR-68-15-VOL-1) Avail: CFSTI CSCL 13/13

The forced response of finite, linearly elastic cylinders with prescribed edge conditions has not been sufficiently studied. Various shell theories have been proposed to examine this problem. The simpler bending theories (called herein classical theories), more amenable to engineering approximation, having been examined by other criteria, may not actually be appropriate to all dynamic problems. Only limited use has been made of these classical theories for dynamic problems, and then only with very specialized edge conditions. More inclusive theories, which include transverse shear deformation and rotary inertia (usually termed refined or SR theories), though developed, have not been used to analyze dynamic problems of this nature. We propose to compare the results of two shell theories, one classical and one SR theory, when they are used to analyze the forced dynamic deformation of an elastic cylinder with free and clamped edges. An essential feature of the analysis is a reliance on Hamiltons Variational Principle as the underlying dominant governing physical law. Beginning with Hamiltons Principle, we have formulated two mutually consistent sets of descriptive equations and boundary conditions, as well as the required conditions of orthogonality. The equilibrium portions of these equations are shown to be identical with particular shell theories, previously developed by Yu, in part of different means. Author (TAB)

N69-10972*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
ON THE STABILITY OF A COLUMN SUBJECTED TO A TIME-DEPENDENT AXIAL LOAD
E. F. Infante and R. H. Plaut [1968] 14 p refs Sponsored in part by Army
(Grants NGL-40-002-015; AF-AFOSR-693-67; Contract DA-31-124-ARO(D)-270)
(NASA-CR-97627) Avail: CFSTI CSCL 20K

Exponential bounds and stability conditions for a linear elastic column subjected to a time varying axial load are derived. The form of stability considered is almost sure asymptotic stability in the case that the load is assumed to be stochastic. Conditions for the almost sure asymptotic stability of the column are given and simultaneously with conditions for asymptotic stability, measures of exponential decay of the solutions are obtained. Stability conditions were obtained first using the modal approach and it is shown that this procedure is unnecessary and that the same estimates and conditions for almost sure asymptotic stability can be obtained in a simple and direct manner from the original partial differential equation. Results obtained are compared to previously published results by Caughey and Gray, Ariaratnam, and Lepore and Shah. S.C.W.

N69-10985#
STABILITY OF A CYLINDRICAL SHELL PARTIALLY FILLED WITH FLUID AND SUBJECTED TO DYNAMIC LOADING
V. S. Pavlovskii [1968] 8 p refs Transl. into ENGLISH from Prikl. Mekh., Akad. Nauk Ukr. RSR (Kiev), v. 4, no. 4, 1968 p 58-65 Presented at the Conf. of Young Res. of the Mech. Inst. AN UkrSSR, 22 Jun. 1967
Avail: CFSTI

Nonlinear differential equations are derived to describe the motion of a cylindrical shell with an initial deflection, partially filled with fluid under pressure and subjected to longitudinal compressive forces. The critical dynamic loading is determined as a result of numerical integration of this system of equations, and the influence of the fluid on its magnitude is also investigated. Author

N69-11000# Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.
APPLICATION OF ELASTIC PLASTIC ANALYSIS TO THE DESIGN OF PRESSURE VESSELS
C. H. A. Townley Jul. 1968 33 p refs
(RD/B/N-1105) Avail: CFSTI

There is an increasing interest in putting the design of pressure vessel details on a scientific basis. Rules based on elastic-plastic behavior, to ensure shakedown and to prevent excessive plastic deformation are currently finding favor. These two concepts and the evidence available to justify their adoption in practical design are discussed. For many types of pressure vessel detail, methods are now available which can provide design charts which are more rational than those in present use. The application of the general method to two specific types of detail, branch openings in cylinders and dished drum ends, are described to illustrate the method. Author (NSA)

N69-11008*# Southampton Univ. (England).
TRANSIENT VIBRATION ANALYSIS OF LINEAR SYSTEMS USING TRANSITION MATRICES
Anthony Craggs Washington NASA Nov. 1968 26 p refs
(Grant NGR-52-025-003)
(NASA-CR-1237) Avail: CFSTI CSCL 20K

A step by step transition matrix method is presented for solving a set of equations of motion. The stability criteria which govern the choice of step size are given in the first part of the report: these are related to the highest eigenvalue of the system under consideration. The use of the technique for evaluating the response to a set of forces and prescribed motions is given in a theoretical discussion. Using the finite element displacement procedure to idealise the structure the method has been applied to several rectangular plate problems and good agreement is obtained between theoretical and experimental results. The results for the transient motion of a simply supported plate are compared with similar results obtained by using a standard 4th order Runge–Kutta procedure and it is shown that the transition matrix solutions are more accurate, and there is also a substantial decrease in the computation time per step. Author

N69-11010*# California Univ., Los Angeles.
GEOMETRIC PROPERTIES OF A PRESTRESSED SEGMENTED SPHERICAL SHELL
R. L. Brackett, F. R. Shanley, and L. P. Felton Washington NASA Nov. 1968 32 p refs
(Grant NSG-423)
(NASA-CR-1231; Rept.-68-23) Avail: CFSTI CSCL 20K

Ceramics are potentially excellent structural materials because of their high moduli of elasticity and great compressive strengths. However, their brittleness, coupled with fabrication difficulties, has been a major drawback to their increased use. The problems might be overcome if structures were to be constructed of small segments with the assemblage being prestressed. This report discusses the design and construction of a plastic model of a prestressed dome constructed of 180 triangular plate segments. Prestressing is accomplished by cables running between segments, parallel to segment edges. Prestressing forces are adjusted by special fittings located around the perimeter of the dome. Author

N69-11014#
VIBRATIONS OF A RECTANGULAR CANTILEVER PLATE WITH STIFFENER RIBS IN A GAS FLOW
Nguen Fuk Nin [1968] 4 p refs Transl. into ENGLISH from Prikl. Mekh., v. 4, no. 9, 1968 p 102–105
Avail: CFSTI

Plates encountered in aircraft construction are usually reinforced by stiffener ribs. The influence of the placement of the ribs on the behavior of a rectangular cantilever plate in a gas flow is investigated. The Lagrange variation equation is used to solve the problem considered. The dependence between the critical flow velocities and the rib stiffeners is studied in detail for plates with one or two ribs. Results are obtained for plates with different side ratios, for different rib locations on the plate, and also for different ratios between the rib and plate masses; they show that the flutter velocity can be raised by not less than 20% by means of a logical selection of the rib location. Auhtor

N69-11064# Case Western Reserve Univ., Cleveland, Ohio. Structures and Mechanical Design Group.
FINITE DEFLECTION, DISCRETE ELEMENT ANALYSIS OF SHELLS
Fred K. Bogner Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Jun. 1968 170 p refs
(Contract AF 33(615)-3432)
(AD-675320; AFFDL-TR-67-185) Avail: CFSTI CSCL 13/13

A discrete element analysis method for predicting the nonlinear response of thin elastic shells is presented. The displacement patterns for a shell element, the edges of which must be parallel to orthogonal curvilinear coordinates, are expressed in terms of products of one-dimensional Hermite interpolation polynomials and undetermined nodal displacement parameters. Geometric admissibility of the displacement state of an assemblage of these discrete elements is conveniently satisfied. Special treatment is given to the particular cases of flat rectangular plate and circular cylindrical shell discrete elements. The use of a potential energy principle permits the incorporation of geometric nonlinearity, thus providing the capability for predicting finite displacements and post-buckling behavior. Numerical solutions are obtained by direct minimization of the total discretized potential energy. Several numerical examples, both linear and nonlinear, which indicate the effectiveness of the analysis are considered. The applicability of this discrete element analysis method to predicting the elastic post-buckling behavior of integrally stiffened shells is provided by the assumed element displacement patterns. Author (TAB)

N69-11070# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE AXISYMMETRIC PROBLEM OF A CIRCULAR CYLINDRICAL SHELL MADE OF MATERIAL WITH DIFFERENT STRENGTH IN TENSION AND COMPRESSION
S. A. Ambartsumyan 7 Dec. 1967 17 p ref Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. (Moscow), no. 4, 1965 p 77–85
(AD-675312; FTD-HT-23-1055-67) Avail: CFSTI CSCL 13/13

The stresses are analyzed in a semi-infinite circular cylindrical shell of constant thickness, made of isotropic material whose elasticity moduli in tension and compression are different. Uniformly distributed bending moments and shear forces act along the circumference of the face of the shell. The hypothesis of preservation of normals is applied, and it is assumed that the material of the shell obeys the generalized Hookes law, but that the Poisson ratios are equal to zero. Author (TAB)

N69-11106
THIN CYLINDRICAL SHELLS SUBJECTED TO AN EXTERNAL PRESSURE PULSE
E. I. Grigoliuk et al [1968] 12 p refs Transl. into ENGLISH from Inzh. Zh., Mekhanika Tverdogo Tela, no. 3, 1968 p 110–118
Avail: CFSTI

The stability of thin circular cylindrical shells subjected to uniform external sinusoidal pressure pulses of sufficient magnitude to cause radial displacements is investigated. An elastic system with k degrees of freedom is considered. The stability of shells submerged in an inviscid and incompressible fluid, or a cavity bounded by a comparatively large annular gap, is also studied considering transverse inertial forces. The system of nonlinear partial differential shallow shell equations in the deflection is reduced to a system of ordinary second order differential equations describing the change in the generalized shell coordinates with time. The solutions of the obtained motion equations for the generalized coordinates are investigated using Liapunov functions to determine the shell stability. B.P.

N69-11115
LAMINAR PANEL FLUTTER IN A SUPERSONIC FLOW
A. I. Smirnov [1968] 5 p refs Transl. into ENGLISH from Izv. VUZ. Aviats. Tekh. no. 2, 1968 p 33–38
Avail: CFSTI

The system of differential equations for the small vibrations of a sandwich plate is reduced for the case of cylindrical flexure in a gas stream, and formulas are included for calculating the characteristics of plates. Aerodynamic loading on a panel in

supersonic flow is determined, with the problem reducing itself to the behavior of roots of a complex variable. Amplitude of the panel vibrations will increase without limit if at least one of these roots is within a specified domain. Laminar panel flutter is obtained using a mapping procedure. M.W.R.

N69-11179
DYNAMIC STABILITY OF AN ORTHOTROPIC CIRCULAR CYLINDRICAL SANDWICH SHELL
G. Z. Mikaelian [1968] 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk Arm. SSR Mekh., vol. 21, no. 2, 1968 p 42–51
Avail: CFSTI

The problem of dynamic stability of a laminar cylindrical shell to whose endfaces compressive, periodically time-varying, stress resultants are applied eccentrically relative to the wall thickness, is considered. It is assumed that the precritical stress state is a couple-stress, axisymmetric state. It is shown that the eccentricity of load application sharply alters the boundaries of the dynamic instability zones. Author

N69-11267*
STABILITY OF A CLOSED TOROIDAL SHELL OF CIRCULAR CROSS SECTION
Iu. A. Fedosov [1968] 7 p refs Transl. into ENGLISH from Gidroaeromekh. i Teor. Uprugosti (Kharkov), no. 7, 1968 p 94–100
Avail: CFSTI

The problem of the nonaxisymmetric buckling mode of a toroidal shell of circular cross section under the effect of uniform external pressure is solved using linear theory. S.C.W.

N69-11270
ON THE DAMPING OF PLANE, EXPLOSIVELY-CAUSED, SHOCKS IN A SOLID
V. N. Kondrat'ev et al [1968] 8 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. USSR), no. 4, 1968 p 61–65
Avail: CFSTI

A hydrodynamic analysis was made using quasi-acoustic approximation to analyze the problem of plane shock damping in a solid when a layer of high explosive is exploded on its surface. Results are compared with experimental data obtained in aluminum and brass from an explosion of charges comprised of an alloy of trotyl and hexogene (TG-50/50). Measurements were made by electrical contact and capacitative methods at various distances from the charge, the maximum distance being tens of thicknesses of the charge. Author

N69-11296
STABILITY OF REINFORCED PLATES AND CYLINDRICAL SHELLS BEYOND THE ELASTIC LIMIT
Iu. V. Nemirovskii [1968] 7 p refs Transl. into ENGLISH from Inzh. Zh., Mekh. Tverdogo Tela, no. 3, 1968 p 168–173 Presented at the 5th All-Union Conf. on Plate and Shell Theory (Moscow), Jan.–Feb. 1965
Avail: CFSTI

A method for determining the stability of shallow reinforced shells and rectangular plates beyond the elastic limit is proposed; and its applicability in the analysis of (1) two layered reinforced sheets consisting of two casing layers and a reinforcing core between them; (2) single layered symmetrically reinforced sheets consisting of a sheet casing strengthened on both sides by a reinforcing inlay, and (3) hinged and unhinged rectangular plates reinforced with longitudinal and transverse ribs is discussed. S.C.W.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N69-10082 Wisconsin Univ., Madison.
USE OF THE ZEEMAN EFFECT FOR THE LOCALIZATION OF RADIATION ABSORPTION-EMISSION IN GASES
Munthir Ismail Aldruby (Ph.D. Thesis) 1967 272 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.50 Order No. 12403

A novel spectroscopic approach for the detection of radiation according to its localized region of origin in a gas was investigated both theoretically and experimentally. Special emphasis was placed on attempting to measure localized gas temperature by spectral line reversal. A hydrogen-air diffusion flame burner was constructed which provided a center flame located in the maximum field strength region (≈3500 gauss) of a non-uniform magnetic field flanked by two outer flames located in the weak field region (≈450 gauss). All flames were seeded with potassium and sodium chlorides. A monochrometer was used to detect the various alkali resonance lines with sufficient spectral resolution to separate the resonance line doublets. The K7699 line was found to be superior to the other lines and received primary attention. The basis objective of this thesis is to investigate both theoretically and experimentally the effect of the absorption cell and the magnetic field on the emission from the flames from the point of view of determining the conditions under which the method of localization mentioned above is experimentally feasible. Dissert. Abstr.

N69-10086 Brown Univ., Providence, R. I.
RADIATIVE TRANSFER IN A GAS OF UNIFORM PROPERTIES IN LOCAL THERMODYNAMIC EQUILIBRIUM
Brian Lindsay Hunt (Ph.D. Thesis) 1967 308 p
Avail: Univ. Microfilms: HC $13.95/Microfilm $3.95 Order No. 68-1469

The work reported here is concerned with the transfer of radiative energy in uniform, nonhydrogenic gases at local thermodynamic equilibrium. Particular interest is taken in the role of the atomic (and ionic) lines in the transfer process. The thermodynamic states of the gases are appropriate to the conditions found in the shock-heated region of air produced by a space vehicle entering the earth's atmosphere. The methods currently available for calculating cross sections for radiative processes are described and compared. An accurate method for calculating the species composition of nitrogen is described and the results of such a calculation are presented. The important line broadening mechanisms are discussed and the potentially accurate, modern theories are used to justify approximate line profiles which are simple enough for use in radiative transfer calculations. Dissert. Abstr.

N69-10192*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ORDERLY THREE-DIMENSIONAL PROCESSES IN TURBULENT BOUNDARY LAYERS ON ABLATING BODIES
Thomas N. Canning, Michael E. Tauber, Max E. Wilkins, and Garry T. Chapman *In* AGARD Hypersonic Boundary Layers and Flow Fields May 1968 14 p refs (See N69-10186 01-01)
Avail: CFSTI CSCL 01A

Results are reported here of tests made with biconic, concave, and convex ablating Plexiglas models in a Mach 7 airstream with maximum local Reynolds numbers approaching 10^7. After they were tested, the model surfaces were carefully examined. In addition

to such well-known features as turbulence wedges and streamwise grooves produced by longitudinal vortices, many parts of the models exhibited a "cross-hatching" pattern, which had been previously observed under other conditions. It was found that the spiral angle of the cross-hatching is close to the Mach angle based on boundary layer-edge Mach number, while the spacing is typically equal to a few boundary layer thicknesses. A physical flow model is outlined which could explain the cross-hatching and other observed patterns. Author

N69-10219 Cincinnati Univ., Ohio.
HEAT TRANSFER BY NATURAL CONVECTION TO A ROTATING PLATE IN SYNCHRONOUSLY ROTATING SURROUNDINGS WITH AND WITHOUT CONSIDERATION OF CORIOLIS FORCES
Mark Manoff (Ph.D. Thesis) 1967 384 p
Avail: Univ. Microfilms: HC $17.55/Microfilm $4.90 Order No. 68-2008

Mathematical models describing transient temperature and velocity distributions adjacent to a cool, isothermal plate subjected to a spatially varying acceleration field have been formulated and solved numerically using finite difference procedures. The physical model, considered is that of a rotating plate in synchronously rotating infinite surroundings. The effect of Coriolis forces is studied in detail and is shown to be primarily dependent on the value of the dimensionless group $\beta\Delta T$. Secondary dependence on the value of the Grashof number and the Prandtl number is exhibited. Laminar solutions are presented for Grashof numbers ranging from -5.0625×10^8 to 5.0625×10^8, for Prandtl numbers of .01, .71, 1.0, and 100.0, and for $\beta\Delta T$ equal to 0.0 (pure centrifugal flow), .0025 and .09. The solutions for these cases $\beta\Delta T = 0.0$ are included to permit an evaluation of the effect of neglecting Coriolis forces for non-zero $\beta\Delta T$. Dissert. Abstr.

N69-10227*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSIENT SOLIDIFICATION OUTSIDE A COOLED PIPE WITH APPLICATION TO A SOLAR BRAYTON HEAT RECEIVER
Wellington W. Hu Washington Nov. 1968 33 p refs
(NASA-TN-D-4897) Avail: CFSTI CSCL 20M

The analysis involves time-variant heat conduction with the liquid-solid boundary moving radially through the axisymmetric heat-storage material as heat is transferred to the flowing cooling medium. Solutions were obtained by simultaneously solving the integrated nonlinear differential equations through numerical means. Quasi-steady radial heat conduction is utilized at an instant of time. Solutions for wall temperature, gas temperature, and solidification thickness along the tube for a 35-minute shadow portion of an Earth orbit are obtained for a solar Brayton heat receiver. A simplified solution neglecting the wall-temperature variation is also derived to compare with the numerical method. Author

N69-10340 Cincinnati Univ., Ohio.
A UNIFIED THEORY OF FILM COOLING
Maido Saarlas (Ph.D. Thesis) 1967 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-2017

A basic theory has been developed for the problem of protecting a wall from the external flow. The effectiveness equations has been derived with only one significant restriction that the flow be steady. Depending on the boundary conditions the theory covers film cooling with an external slot, with a wall slot, and transpiration cooling in low speed or high speed flow with or without the external pressure gradient. The key parameters are the boundary layer and the enthalpy thicknesses which must be obtained from appropriate boundary layer models. An improved two layer model including the effect of coolant injection has been established to determine these parameters for the case of an external slot. The agreement with experimental data is good. Furthermore, it was found that using the ordinary turbulent no-injection boundary layer thickness and the asymptotic value of the enthalpy thickness can provide, in many cases, rough estimates for the film cooling effectiveness. Dissert. Abstr.

N69-10420*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL STUDIES ON SHADOW SHIELDS FOR THERMAL PROTECTION OF CRYOGENIC TANKS IN SPACE
Richard H. Knoll and Edward R. Bartoo Washington Nov. 1968 73 p refs
(NASA-TN-D-4887) Avail: CFSTI CSCL 20M

Experiments were performed on multiple flat-disk shadow shields to determine the effects of shield spacing, number, emissivity, lateral conductance, and targeting (high-emissivity coatings on annular rings of shields) on thermal performance. The experimental data, in general, agreed closely with an analytical model which assumed diffuse surfaces with nonuniform radiosity. A shadow-shield system for a hypothetical space vehicle was designed, scaled down, and tested. Results demonstrated: (1) a lightweight method of shield construction; (2) shield-support interactions; and (3) reduction of support heat leaks by shield location, attachment methods, and the use of high-emissivity coatings. Author

N69-10422 Michigan Univ., Ann Arbor.
BOILING OF LIQUID NITROGEN IN REDUCED GRAVITY FIELDS WITH SUBCOOLING
Eugene Walter Lewis (Ph.D. Thesis) 1967 241 p
Avail: Univ. Microfilms: HC $11.05/Microfilm $3.15 Order No. 67-17807

Pool boiling of liquid nitrogen in a body force field less than standard gravity was studied using a transient calorimeter measurement technique. Experimental variables included: body forces from standard gravity to near-zero; a variety of geometries and orientations of the boiling surface; subcooling from 0°F to 30°F; pressures from 1 to 5 atm; and boiling regimes from film to nucleate, plus free convection. Gravity was varied by using a drop tower and a counterweighted test package. In free fall, the test package achieved a level of less than 0.002 times standard gravity. Heat transfer surfaces included 1/4-, 1/2-, and 1-inch diam spheres and a 3-inch diam by 13/16-inch thick disk oriented vertically, horizontally heating up, and horizontally heating down. Subcooling was achieved by rapid pressurization of the liquid nitrogen; 3 and 5 atm were used, providing maximum subcooling of approximately 20°F and 30°F. Results were obtained in the form of time vs. surface temperature, which were then expressed as heat flux vs. the difference between the test surface temperature and saturated liquid temperature. Dissert. Abstr.

N69-10429*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
APPLICABILITY OF DILUTE GAS TRANSPORT PROPERTY TABLES TO REAL GASES, VOLUME 8, NUMBER 2
G. E. Childs and H. J. M. Hanley Apr. 1968 4 p refs
(NASA Order R-06-006-046)
(NASA-CR-97568; PB-178751; R-456-Vol-8-No-2) Avail: CFSTI CSCL 20M

The article defines the pressure range for which published transport tables may be applied to experiment. It is shown that the upper limit of this range is more than one atmosphere, the arbitrary pressure which is frequently assumed to be the highest pressure allowed. Author (USGRDR)

N69-10458*# Volt Information Sciences, Inc., Washington, D. C.
AERODYNAMIC HEATING OF THE LIFTING BODIES [AERODINAMICHESKOYE NAGREVANIYE NESUSHCHIKH TEL]
G. I. Maykapar Greenbelt, Md. NASA. Goddard Space Flight Center 3 Nov. 1968 12 p refs Transl. into ENGLISH from Russian Presented at AIAA 5th Ann. Meeting, Philadelphia, 21–24 Oct. 1968
(Contract NAS5-12487)
(NASA-CR-97576; ST-AD-HT-10770) Avail: CFSTI CSCL 20D

Singularities are considered in the heat flow distribution over the surface of vehicles using the aerodynamic lift. Heat flow maxima may appear on the lower vehicle's surface (attached flow) as a consequence of the large curvature of the edges and on its upper surface in the case of detached flow. The results are presented of laminar boundary layer calculations and of the experiments in supersonic wind tunnels. Author

N69-10473*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL ANALYSIS OF SHADOW SHIELDS AND STRUCTURAL MEMBERS IN A VACUUM
Robert J. Boyle and Richard H. Knoll Washington Nov. 1968 125 p refs
(NASA-TN-D-4876) Avail: CFSTI CSCL 20M

An analysis considering nonuniform radiosity and assuming diffusely emitting and reflecting surfaces is presented. The shields are planar and circular, while the sources may be surfaces of revolution. The effects of source geometry, number of shields, spacing, and surface properties are discussed. Shield conductivity and selective coatings are investigated. Specularly and diffusely reflecting surfaces are discussed under the simplifying assumption of uniform radiosity. Also, the effects of thermal radiation on the temperatures of a conducting structural member are analyzed. Results are presented showing the effects of significant parameters on the temperature profiles and heat transfer rates. The computer program for the shield analysis is listed. Author

N69-10493*# Scripta Technica, Inc., Washington, D. C.
RADIATIVE HEAT EXCHANGE BETWEEN CONCENTRIC SPHERES WHEN THE TEMPERATURE AND THE EMISSIVITY ARE NONUNIFORM [SCAMBIO TERMICO RADIATIVO TRA SFERE CONCENTRICHE IN PRESENZA DI TEMPERATURA ED EMISSIVITA' NON UNIFORM]
C. Arduini NASA Nov. 1968 31 p refs Transl. into ENGLISH from Italian
(Contract NASw-1694)
(NASA-TT-F-11911) Avail: CFSTI CSCL 20M

Consideration is given to the problem of radiative heat exchange between a body and its enclosure in the case in which the temperature and emissivity are not uniform on the surfaces. An exact series solution is presented. The terms of the series are deduced from the specified distribution through the iterative application of particular integral operators. The explicit form of these operators is given for a centered two-sphere system with axisymmetrical distribution. A numerical example shows how the effect of the nonuniformity depends mainly on the hemisymmetrical components of the distribution. For these components the heat exchange decreases in the hotter points and vice versa. Author

N69-10509# Technische Hogeschool, Delft (Netherlands).
ON THE APPLICATION OF THE SEMI-CLOSED THERMOSYPHON SYSTEM TO GAS TURBINE BLADE COOLING
Vilas Avadhut Ogale (Ph.D. Thesis) 1968 213 p refs
Avail: Issuing Activity

The application to gas turbine blade cooling of the semi-closed thermosyphon system is discussed. In particular, the system investigated involves blades filled with liquid metals and closed at both ends. The heat from the gas to the rotor blades is transferred to the blade root by using the liquid metal as primary coolant. A secondary coolant (distilled water) removes the heat from the blade root. A stationary test rig to investigate the heat transfer from blade to primary coolant is described. Digital and analog computer results are given for the chordwise temperature distribution under varying operating conditions. The stresses in a cooled blade are analyzed and the blade life prediction based on these calculated stresses is given. The influence of the trailing edge thickness on the aerodynamic losses in a gas turbine is discussed. Theoretical and experimental data resulting from the investigation are applied to the design of an experimental cooled gas turbine stage. Author

N69-10521*# Rice Univ., Houston, Tex.
HEAT EXCHANGERS FOR CONVECTIVE AND RADIATIVE ENVIRONMENTS
D. B. Mackay Aug. 1968 125 p refs *Its* Aerospace Technol. Rept. 4
(Grant NGR-44-006-033)
(NASA-CR-97581) Avail: CFSTI CSCL 13A

Presented are two IBM-7040 Fortran Programs, numbers 4–1 and 4–2 for the analysis of steady state liquid heat exchange systems composed of ducts and extended surfaces (fins). The system exchanges heat with its environment by radiation, convection or both, under conditions where the environment parameters are invariant with position along the tube or duct. The programs calculate heat exchanged, fluid and duct temperatures, friction pressure drop and a number of heat exchange parameters. Common input data include system dimensions, material and liquid properties, flow rate, and environmental conditions. Program 4–1 is applicable to environments where as many as three external bodies may be present to effect the radiation heat transfer. One of these bodies is assumed to be the sun. The system configuration is limited to round tubes and asymmetrical fins. Program 4–2 is applicable to innumerable geometric configurations including noncircular ducts, irregular shaped fins and fin spacing. Each fin can have its individual material properties and environment. However, fin performance information has to be established by techniques which are not included in Program 4–2. Author

N69-10655# Iowa State Univ. of Science and Technology, Ames.
THRESHOLDLESS CONVECTION IN LIQUID METAL DIFFUSION COEFFICIENT MEASUREMENTS
J. D. Verhoeven Aug. 1968 13 p refs
(Contract W-7405-ENG-82)
(IS-1860) Avail: CFSTI

Horizontal density gradients may arise in the capillary tubes used to measure liquid metal diffusion coefficients as a result of cyclic temperature control. Such gradients will produce natural convection of the metal in the capillary tube. An approximate analysis has been carried out to determine the magnitude of the error which such convection would produce in the measured values of the diffusion coefficients. The results indicate that the errors would be negligibly small in liquid metal systems but might be appreciable in systems having smaller thermal diffusivities. Author (NSA)

N69-10688# Los Alamos Scientific Lab., N. Mex.
THE THERMAL CONDUCTIVITY OF He-4 I NEAR THE λ-LINE AND OF He-3 NEAR THE LIQUID-VAPOR CRITICAL POINT
J. E. Kerrisk and W. E. Keller [1968] 4 p refs Presented at the Conf. on Low Temp. Physics, St. Andrews, Scotland
(Contract W-7405-eng-36)
(LA-DC-9703; CONF-680808-2) Avail: CFSTI

Measurements of the coefficient of thermal conductivity, K(T,P), were made for liquid ^{4}He I between 1.77 and 4.0 K, and for fluid ^{3}He between 1.5 and 4.0 K, both at pressures up to 34 atm. A steady state method with a fixed separation parallel plate cell was used. Heat produced electrically in the upper plate passed through the 0.082 cm thick He layer to the lower plate, which was in contact with a ^{4}He bath. The empty cell was calibrated to assess the heat flow through paths other than the He layer. The effects of convection and thermal boundary resistance were determined; including these, the data are considered accurate to ±3% though the precision is in general better than ±1%. Author (NSA)

N69-10779*# Radiation Research Associates, Inc., Fort Worth, Tex.

INELASTIC NEUTRON AND CAPTURE GAMMA-RAY CROSS SECTION LIBRARIES FOR THE COHORT MONTE CARLO PROCEDURE

J. D. Marshall 16 Feb. 1968 146 p refs

(Contract NAS8-21104)

(NASA-CR-98102; RRA-T83) Avail: CFSTI CSCL 20M

A set of cross section libraries was compiled for the family of routines designated as COHORT. The elements for which these libraries were compiled are Li^6, Li^7, Be^9, B^{10}, C, N, O, Al, Fe, and U^{235}. These elements are those typically encountered in nuclear rocket radiation heating and transport problems, although they are not restricted to that type problem. The set of compiled libraries does not include all of the cross sections required for a complete COHORT calculation but it does include those libraries dealing with the production of secondary gamma rays by neutron capture or inelastic scattering. It is hoped that these libraries will be useful to all those who use the COHORT Monte Carlo procedure. Author

N69-10819*# Boeing Co., Seattle, Wash. Space Div.

CHARRING ABLATION PERFORMANCE IN TURBULENT FLOW. VOLUME 1: ANALYTICAL AND EXPERIMENTAL STUDIES

R. S. Gaudette, E. P. del Casal, and P. A. Crowder Sep. 1967 198 p refs

(Contract NAS9-6288)

(NASA-CR-65736; D2-114031-1) Avail: CFSTI CSCL 20M

The ablation performance of Avcoat 5026-39HC/G in turbulent boundary layer flow is investigated analytically and experimentally. An integral method is used to determine the heat, mass, and momentum transfer in the equilibrium boundary layer with mass injection for the laminar through fully turbulent flow regimes. Phenomena occurring on the surface of or within the ablating material are correlated when possible on the basis of analytical models developed, as well as experimental data. Solutions of these two analyses are coupled through the surface temperature and mass injection rate. Overall ablation performance can then be described for various environmental conditions. Specifically, the Apollo heat shield performance is predicted at selected body locations for two trajectories. The results show that ablation performance can be predicted with reasonable confidence using semiempirical correlation techniques verified by experimental data; however, extrapolation to regimes significantly beyond those verified and to other materials will require additional experimental data. Author

N69-10820*# Boeing Co., Seattle, Wash. Space Div.

CHARRING ABLATION PERFORMANCE IN TURBULENT FLOW. VOLUME 2: COMPUTER PROGRAM

R. Colony, E. P. del Casal, and R. S. Gaudette Nov. 1967 112 p refs

(Contract NAS9-6288)

(NASA-CR-65807; D2-114031-2) Avail: CFSTI CSCL 20M

The two computer programs described are in support of an integrated analytical and experimental investigation to predict the ablation performance of the Apollo heat shield. The principal objective was the determination of the ablation performance under turbulent flow conditions of AVCOAT 5026-39HC/G used on the Apollo vehicle. These programs, which are written in FORTRAN 4, are machine independent and as much as possible system independent. Author

N69-10836# General Electric Co., Schenectady, N. Y. Research and Development Center.

HEAT TRANSFER AND HYDRAULICS: THE EFFECTS OF SUBCOOLED VOIDS Quarterly Report, Apr.–Jun. 1968

F. W. Staub, G. Walmet, and R. O. Niemi Jun. 1968 96 p refs Sponsored in part by EURATOM

(Contract AT(30-1)-3679)

(NYO-3679-5; EURAEC-2052; QR-5) Avail: CFSTI

An experimental and analytical program directed toward the determination of the void distribution, location of the initiation of the net vapor generation, pressure drop, and heat transfer coefficients in subcooled boiling water systems is discussed. The measurement of the initiation and early development of the subcooled void profile was carried out, including all required profile measurements and observations, with low pressure water. The void profile and the pressure drop and heat transfer measurements will be extended to a reduced pressure range of 0.1 to 0.7 and the higher quality regions, using the Refrigerant-22 facility. The void profiles, pressure drop and heat transfer coefficients will be measured at a reduced pressure of about 0.4 to 0.5 in water. All water experiments will be conducted with and without a reactivity and a pH control additive to determine their effect at both low and high pressures. The objectives of the analytical effort are to derive general equations which accurately predict the void fraction, pressure drop, and heat transfer coefficients in two-phase flow with subcooled boiling for various fluids and over a wide range of operating condition. Emphasis is placed on the formulation of the point where net vapor generation is initiated, in subcooled boiling, in terms of the surface and fluid properties, local geometry, and the operating characteristics of the system. Author (NSA)

N69-10843# General Electric Co., Schenectady, N. Y. Research and Development Center.

HEAT TRANSFER AND HYDRAULICS: THE EFFECTS OF SUBCOOLED VOIDS Quarterly Report, Jan.–Mar. 1968

F. W. Staub, G. Walmet, and R. O. Niemi Apr. 1968 77 p refs Sponsored in part by EURATOM

(Contract AT(30-1)-3679)

(NYO-3679-4; EURAEC-2013; QR-4) Avail: CFSTI

An experimental and analytical program directed toward the determination of the void distribution, location of the initiation of net vapor generation, pressure drop, and heat transfer coefficients in subcooled boiling water systems is discussed. The measurement of the initiation and early development of the subcooled void profile, including all required profile measurements and observations, with low pressure water is described. Void profiles, pressure drop and heat transfer coefficients will be measured at a reduced pressure of about 0.4 to 0.5 in water. All water experiments will be conducted with and without a reactivity and a ph control additive to determine their effect at both low and high pressures. The objectives of the analytical effort were to derive general equations which accurately predict the void fraction, pressure drop, and heat transfer coefficients in two-phase flow with subcooled boiling for various fluids and over a wide range of operating conditions. Emphasis will be placed on the formulation of the point where net vapor generation is initiated, in subcooled boiling, in terms of the surface and fluid properties, local geometry, and operating characteristics of the system. Author (NSA)

N69-10921# Library of Congress, Washington, D. C. Aerospace Technology Div.
ZERO-GRAVITY EFFECTS ON BOILING HEAT TRANSFER AND THE CRITICAL HEAT FLUX
Anatol Surak *In its* Foreign Sci. Bull., Vol. 4, No. 10 Oct. 1968 p 1–14 refs (See N69-10920 01-34)
Avail: CFSTI

The experimental apparatus is described and the results are presented of Soviet investigations of boiling heat transfer and the critical heat flux in a forced upward flow of water in tubes under zero gravity conditions. Author

N69-10929# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT EXCHANGE DURING CONDENSATION OF POTASSIUM AND SODIUM VAPOR
V. I. Subbotin et al 29 Mar. 1968 14 p refs Transl. into ENGLISH from Teplo- i Massoperenos (Minsk), 1966 p 247–255
(AD-675226; FTD-MT-24-54-68) Avail: CFSTI CSCL 11/7

Experimental data are given on heat exchange during condensation of potassium and sodium vapor as a function of boundary effects: thermal contact resistance due to wall contamination; phase transition resistance due to the sharp temperature difference between the vapor and the liquid surface; and diffusion resistance due to an admixture of noncondensable gases in the metal vapor. Author (TAB)

N69-10932*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
ROTATIONAL AND VIBRATIONAL TEMPERATURE MEASUREMENTS IN THE 12-INCH HYPERSONIC CERAMIC-HEATED TUNNEL
John C. Hoppe Washington Nov. 1968 37 p refs
(NASA-TN-D-4892) Avail: CFSTI CSCL 20M

An electron beam fluorescence technique has been employed to measure free-stream nitrogen rotational and vibrational temperatures in air at the Langley 12-inch hypersonic ceramic-heated tunnel. This work included establishing the sources of measurement uncertainty and minimizing their effect on the temperature measurements. An extensive laboratory study to determine the accuracy of the instrument system preceded tests made at the facility. Measurements obtained at the facility included a rotational temperature range from 39°K to 72°K and a corresponding vibrational temperature range from 850°K to 1320°K. In addition, static translational temperatures were determined as well as the condition of nonequilibrium existing in the gas expansion. Uncertainties in these measured temperatures are estimated to be ±5 to ±7 percent for the rotational temperatures, and ±15 percent for the vibrational temperatures. During the preliminary laboratory investigation of the technique for vibrational temperature measurement, experimental evidence indicated that at least one reported transition probability needed correction. In addition, some deviation from the expected linear analysis for rotational temperature was experienced. Finally, the measured temperatures generally agree with aerodynamic predictions and fall between the extreme frozen flow and equilibrium flow cases. A first-order nonequilibrium theory fits the observations approximately. Author

N69-10980# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMOCHEMICAL STUDY OF INDIVIDUAL EXPLOSIVES AND THEIR MIXTURES
Yu. A. Lebedev et al 25 Apr. 1968 17 p refs Transl. into ENGLISH from Nauchn.-Tekhn. Gorn. Obshch. Vzryvnoye Delo (USSR), 1963 p 80–90
(AD-675457; FTD-MT-24-98-68) Avail: CFSTI CSCL 19/1

Using the example of cyclonite, the author determines the effect of explosion conditions on the measured thermal effect. The effect of loading density, diameter of charge, weight of charge and dispersion conditions of the explosion products are examined. Five types of bomb calorimeters are employed. The last part of the article examines the effect of additives to the explosive, in particular aluminum and water. Author (TAB)

N69-11028# Institute of Nuclear Research, Warsaw (Poland).
ELECTRIC RESISTANCE ANALOGY FOR HEAT TRANSFER STUDIES. PART 1: THE METHOD AND COMPUTER DESCRIPTION
A. Strupczewski 1968 48 p refs
(INR-Pt-1) Avail: CFSTI

A new resistance-network analog computer for the solution of heat-flow problems under transient conditions is described. In the computer, electrical networks represent the difference equations governing the problem to be solved. Temperature is represented by voltage, the spatial features of the problem by a network of parallel resistances, and the thermal constants by series resistances. A solution in steps Δt of time is obtained by successive readjustments of potentiometers supplying the voltages to the network. The method is very flexible, the time interval Δt and the thermal constants being adjustable during the progress of the work. The computer allows solution of problems involving heat transfer across a surface, or generation or absorption of heat in the interior of the system. The method can be also applied to latent-heat problems. One of the outstanding features of the computer is its stability, independent of the choice of time and thermal constants. Accuracies of better than 1 per cent can be obtained. Author (NSA)

N69-11054# Royal Aircraft Establishment, Farnborough (England).
FLIGHT TEMPERATURE PREDICTIONS FOR FALSTAFF FINS
D. Purslow Nov. 1967 34 p refs
(RAE-TR-67294) Avail: CFSTI

A method is presented of determining the structural flight temperature distributions for high speed vehicles. The results of such calculations for Falstaff fins are presented for comparison with subsequent laboratory and flight tests. Author

N69-11058# Boeing Co., Seattle, Wash. Aerospace Group.
THERMAL PROPERTIES OF ABLATIVE CHARS Final Report, 1 Mar. 1966–15 Sep. 1967
Wilson A. Clayton, Paul B. Kennedy, Robert J. Evans, J. E. Cotton, A. C. Francisco et al Wright-Patterson AFB, Ohio AF Mater. Lab. Jan. 1968 252 p refs
(Contract AF 33(615)-3804)
(AD-675179; AFML-TR-67-413) Avail: CFSTI CSCL 11/4

The objective of this program was to determine thermal conductivity, specific heat, thermal expansion and density to 4500F on well-defined samples of charred phenolic-carbon and phenolic-graphite ablators. Methods were to be established for characterizing chars of three phenolic carbon or phenolic graphite ablators from tested full scale hardware. Then methods for producing stable duplicates of three zones between 1200 and 4500F in each char were to be developed. Samples of each of these zones and the virgin ablator were to be produced for measurement of thermal conductivity, specific heat and thermal expansion by Battelle Memorial Institute. Properties parallel to and perpendicular to the laminate were to be determined from room temperature to 700F on virgin material and between 1200 and 4500F on chars. Properties for the unstable pyrolysis zone were to be derived by extrapolation guided by characterization and heat transport theory. Author (TAB)

N69-11134#
AERODYNAMIC HEATING OF LIFTING BODIES

G. I. Maikapar [1968] 8 p refs Transl. into ENGLISH Presented at IAF Meeting, New York, Oct. 1968
Avail: CFSTI

Singularities of the heat flux distribution over the surfaces of vehicles using aerodynamic lift are discussed, and results are presented for computations of the laminar boundary layer and experiments at supersonic velocities. It is shown that heat flux distribution over the surface of a lifting vehicle of a simple shape can differ substantially from that over the surface of a ballistic and slip-type missile. Further lifting vehicles have aerodynamic controls, projecting superstructures, breaks in the edges, and other characteristics that can cause heat flux peaks associated with interference between waves and boundary layer. One of the heat shielding methods for surface regions with large heat fluxes is the blowing of gas into the boundary layer from within the vehicle, although there are some difficulties associated with the regulating coolant discharges and other parameters. This method is discussed, as are the heat flux distributions over various surfaces of a lifting body. M.W.R.

N69-11201# Applicazioni e Ricerche Scientifiche, Milan (Italy).
A THEORETICAL ANALYSIS OF SOME MODELS FOR STEADY BURNOUT Final Report
L. Biasi, G. C. Clerici, R. Sala, S. Garribba, and A. Tozzi Brussels EURATOM 1966 166 p refs
(Contract EURATOM-106-66-12-TEEI)
(EURAEC-2025; EUR-3800) Avail: CFSTI

A study of the heat transfer crisis in circular ducts with positive quality at the outlet is described. Two approaches were followed in the work: the first was a theoretical study on liquid film flowrate under heat transfer conditions, with the air of predicting film dryout; the second was an examination of experimental burnout data with the goal of correlating them by means of a simple analytical expression. The principal characteristics of an adiabatic model are briefly summarized. A kinetic equation, relating the film flowrate to the departure from equilibrium, is derived. The equation is applied to predict the critical heat fluxes leading to dryout at the duct outlet for given inlet conditions (mass flowrate, quality, pressure, and duct radius). The results obtained are compared with the corresponding experimental burnout data for uniform heating and hot patch, assuming equilibrium inlet conditions. NSA

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N69-10334# Congress. Senate. Committee on Aeronautical and Space Sciences.
NASA'S PROPOSED OPERATING PLAN FOR FISCAL YEAR 1969
Washington GPO 1968 50 p Hearing before the Comm. on Aeronautical and Space Sciences, U. S. Senate, 90th Congr., 20 Sess., 3 Oct. 1968
Avail: Issuing Activity

This is the minutes of NASA's proposed budget for fiscal year 1969 presented before the Committee on Astronautical and Space Sciences. Mr. James E. Webb details his operating plans in support of a budget request and describes the current status of the Nations's space effort. G.G.

N69-10486*# Midwest Research Inst., Kansas City, Mo.
STUDY OF A CONTRACTORS CAPABILITIES CENTER AND THE TECHNOLOGY TRANSFER PROCESS Final Report, 15 Mar. 1966–30 Jun. 1968
Robert E. Roberts and Howard Gadberry [1968] 56 p ref
(Contract NASr-83(09))
(NASA-CR-97583) Avail: CFSTI CSCL 05A

Surveys were conducted to examine the feasibility of a comprehensive, multi-user, NASA Contractors Capabilities Center which would augment the existing, informal system of capability identification, expression, communication, and application. Selected NASA contractors were interviewed to define broadly the types of capabilities they had developed, descriptive information required, and major constraints to be recognized in the design of the Center, and to express their opinions as potential suppliers of information and as potential users of the output. The interview findings disclosed that capability identification and expression was an extremely complex process which presented both conceptual and information processing problems. The implications of these views are assessed, and the design of approaches to speed technology transfers is considered. It was concluded: (1) Broad purpose multi-client capabilities files present difficulties and costs which outweigh the present need for such centralized systems. (2) Any NASA contractor capability file created to serve Technology Utilization should be designed for that audience alone, and should be kept small and highly specialized. M.G.J.

N69-10811*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37–52, VOLUME 3 FOR THE PERIOD JUNE 1 TO JULY 31, 1968. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
31 Aug. 1968 264 p refs
(Contract NAS7-100)
(NASA-CR-97485; JPL-SPS-37-52, Vol. 3) Avail: CFSTI CSCL 22

An overview is presented on the various research projects pertaining to systems analysis, system design and integration, guidance and control, electronic packaging and cabling, propulsion, space sciences, telecommunications, and objectives for roving vehicles in a lunar exploration program. Among the specific projects discussed are: partial derivatives of the two-body problem, a computer program for least-squares fitting segmented cubic polynomials having a continuous first derivative, entry and landing capsule system, thermionic converter technology, noise measurements on a double-injection silicon diode, solid propellant rocket motor command termination by water injection, lithium-boiling potassium test loop runs with reactor simulator, developmental flight-model infrared interferometer, lunar and planetary instruments, magnetic topology and flux reconnection, and spacecraft telemetry and command. M.G.J.

N69-10862*# National Aeronautics and Space Administration, Washington, D. C.
APPLICATIONS OF SYSTEMS ANALYSIS MODELS: A SURVEY
1968 73 p Prepared for NASA by ABT Assoc. Inc.
(NASA-SP-5048) Avail: SOD $0.50 CFSTI CSCL 05A

This publication discusses the adaptation and application of know-how and methods that NASA has used to problems that continually confront management, for example, long-range planning, cost effectiveness and control, and market development. It also deals with the use of these modern techniques in urban and regional planning, and points out their potential helpfulness to city officials and the administrators of public health, educational, and other programs. It emphasizes NASA-funded work that may be as meaningful outside the aerospace field as it has been within it. Author

N69-10717# Select Committee on Small Business (U. S. House).
THE POSITION OF SMALL BUSINESS IN GOVERNMENT PROCUREMENT

Washington GPO 1968 1334 p Hearings before Subcomm. No. 2 on Govt. Procurement and Econ. Concentration of the Select Comm. on Small Business, 90th Congr., 17, 18 and 25 Oct., 1 Nov., 4–5 Dec. 1967, 23 Jan., 13–14 Mar., and 11 Jun. 1968
Avail: SOD

The hearings of the Subcommittee on Government Procurement and Economic Concentration of the Select Committee on Small Business are reported. Included are: (1) government agencies testifying, (2) government agencies reporting, (3) private industry testimony, (3) comments by government agencies in response to industry views and complaints, and (4) Small Business Administration testimony. Additional information concerning actions of government agencies is included in the appendexes. F.D.S.

N69-10735# California Univ., Livermore. Lawrence Radiation Lab.
HAZARDS CONTROL Progress Report, Jan.–Apr. 1968
[1968] 37 p refs
(UCRL-50007-68-1; PR-30) Avail: CFSTI

Topics included in the hazards control report were air sampler arrays for close-in monitoring during underground nuclear testing, particle size distributions as a function of time within artificially produced clouds, detection of argon-41 in environmental air using gamma spectroscopy, effect of smoke on the formation and stability of high expansion foam, smokes from smoldering and burning materials, monthly summaries of lower atmospheric temperature lapse, and coatings and metals in ductwork environments. NSA

N69-10831# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
MODELS AND TECHNIQUES FOR URBAN PLANNING Final Report
Douglass B. Lee, Jr. Sep. 1968 290 p refs
(CAL-VY-2474-G-1) Avail: Issuing Activity

Presented are urban planning models to provide information for technically skilled persons in applying quantitative methodology to the modeling of urban phenomena. Described are a number of abstract attributes, a variety of concepts and techniques, and an overview of the modelling process. Models are classified according to projected purpose. G.G.

N69-10914# Princeton Univ., N. J. Center of International Studies.
AUTHORITY RELATIONS AND GOVERNMENTAL PERFORMANCE. A THEORETICAL FRAMEWORK
Harry Eckstein Sep. 1968 71 p refs
(Contract Nonr-1858(54); ARPA Order 737)
(AD-675327; TR-1(68-1)) Avail: CFSTI CSCL 5/1

This paper presents authority patterns as one aspect of the framework of a research project in comparative political sociology now being carried out by a group of faculty members and graduate students. After summarizing the concerns, reflections, and previous work out of which the project developed, it states and explains the principal hypotheses that the research is intended to investigate. Subsequent reports on the framework of the project will cover the concepts used in it and the manner in which the concepts have been operationalized to make possible the systematic gathering of pertinent data and the measurements required to evaluate the hypotheses. Author (TAB)

N69-10920# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 4, NO. 10
Oct. 1968 61 p refs
Avail: CFSTI

CONTENTS:

1. ZERO GRAVITY EFFECTS ON BOILING HEAT TRANSFER AND THE CRITICAL HEAT FLUX A. Surak p 1–14 refs (See N69-10921 01-33)

2. THE 2-BEV LINEAR ELECTRON ACCELERATOR AT THE KHAR'KOV PHYSICOTECHNICAL INSTITUTE A. Polushkin p 15–25 refs (See N69-10922 01-11)

N69-11182# Naval Research Lab., Washington, D. C.
NAVAL RESEARCH LABORATORY Progress Report, Sep. 1968
Sep. 1968 30 p refs
Avail: CFSTI

Activities of the scientific program at the Naval Research Laboratory are summarized, and an article is presented on the inelastic electron scattering of magnesium 26 at 180 degrees at bombarding energies of 39 and 56 MeV. Eight magnetic dipole transitions were found at the 1+ states; and the strongest transition was at 13.33 MeV, with a ground state radiation width of 14.5 eV. Notes are included on the nondestructive testing for void content in glass-filament-wound composites, a sea water battery for a sonobuoy, normal mode theory for combined structures, and a variety of studies related to metallurgy. An empirical approach to thermal neutron absorption cross sections is reported, as are studies dealing with nitrogen laser power density, frequency translation through a rotating birefringent medium, and attenuation of microwave radiation. Automatic control for recording spectrophotometers and the manufacture of polyethylene substrates for wire grating infrared polarizers are discussed. Published reports, papers, and patents from the laboratory are listed. M.W.R.

N69-11183# Naval Research Lab., Washington, D. C.
NAVAL RESEARCH LABORATORY Progress Report, Aug. 1968
Aug. 1968 43 p refs
Avail: CFSTI

Research programs at the Naval Research Laboratory are reviewed; and a paper is included on the hard-core experiment for the Pharos 2-MJ theta pinch facility. A 700-kilojoule, 100-kilovolt capacitor bank supplies the energy for the hard-core circuit, which was designed to give a theta-field, near the inner surface of the plasma, whose rise time and magnitude are equal to that of the z-field from a 2-megajoule theta pinch circuit. Summaries deal with solar X-ray photometry, surfacd chemistry and lubricants, and protective surfaces. Metallurgical studies are reported on failure analysis, environmental fatigue, crack growth, and stress corrosion. The servo transfer logic circuit is discussed, as is the modification of the air–sea interface by artificial sea slicks. A waveguide tunnel-diode amplifier, residual emission in large intensifiers, and room temperature electron emission were studied, and attention was given to the shear strength of metals and X-ray determination of Bi III–IV transition pressure. A note is included on the crystal geometry for enhanced optical path length. M.W.R.

N69-11265*# Denver Research Inst., Colo.
PROJECT FOR THE ANALYSIS OF TECHNOLOGY TRANSFER Quarterly Report, 13 Jul.–12 Oct. 1968
Theodore D. Brown, R. O. Morgan, Dean R. Lessley, William M. Hildred 18 Oct. 1968 199 p refs
(Contract NSR-06-004-083)
(NASA-CR-97464; QR-3) Avail: CFSTI CSCL 05B

An analysis of nonrespondents and their characteristics was conducted to assess the potential bias built into the Transfer Data Bank resulting from nonresponse to follow-up questionnaires sent to persons requesting Technical Support Packages (TSP). Based upon an examination of general statistical characteristics of

all information requestors and a review of the telephone interviews, it was concluded that nonresponse is a random phenomenon or is caused by factors which were not subject to investigation. Therefore, current procedures are considered to produce representative data. Special questionnaires ware sent to information requestors to determine what they would be willing to pay in order to obtain TSP. Although the economic meaning is limited, it is felt that the data may be useful in formulating future pricing guidelines. The use and application of selected TSP are documented. Also presented is a course outline and study materials for a program of instruction about technology transfer and utilization. M.G.J.

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